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GLOSSARY OF TERMS used in ANIMAL BEHAVIOR and EVOLUTION

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A. In population genetics, a symbol designating a particular allele. (WB)

Abiotic. A term pertaining to substances or objects that are non-biologic in origin. (WS).

Abnormal behavior. May occur as a result of any pathological condition in an animal, but the term is often associated with experimentally induced or captivity related anxiety. (DM)

ABS. Animal Behavior Society (U.S. national professional organization).

Acceleration. A speeding up of development in ontogeny so that a feature appears earlier in the ontogeny of a descendant than it did in the ancestor. (SG) Peramorphosis due to rate change.

Acclimatization. A form of reversible physiological adaptation by which an animal is able to alter its tolerance of environmental factors. (DM)

Accommodation. An adaptive reversible modification of the eye, specifically of the lens, which permits perception of a continuously sharp image regardless of the distance to the object. (H)

Acoustic. referring to hearing and sounds. [HWS]

Acquired behavior. Behavior that has been experimentally demonstrated, in either its topography or stimulus control or both, to be dependent in part upon the operation of variables encountered in conditioning and learning, such as the occurrence of reinforcing stimuli.

Acquired releasing mechanism. The ARM is a releasing mechanism which an individual has acquired during its ontogeny. (H) (in contrast to innate releasing mechanism. (IRM)

Acquisition. (1) Progressive increments in response-strength observed over the series of occasions on which the response is measured. (2) Any modification of behavior in which a response changes in strength or topography, or occurs in new environments. (V)

Action pattern. A series of actions having consistent form in a species. see fixed or modal action pattern [HWS]

Action potential. Changes in electric potential on the membranes of living cells, resulting from cell stimulation, leading to an all-or-nothing action current. (H) An abrupt change in the charge

differential across the membrane of a nerve cell caused by a change in the permeability of the membrane to sodium ions; the nerve impulse. [JA]

Action-specific energy, specific action potential SAP. From the Lorenzian model, the energy that accumulates. This is a hypothetical construct inferred from changes in stimulus threshold, intensity, and rate of occurrence of an unlearned response over time and with the frequency of occurrence of the response. SAP decreases when a response is performed; it then recovers with time in the absence of a response. (V)

Activational Effect. The capacity of key hormones to cause certain behavioral responses to occur by activating proximate mechanisms underlying the behavior. [JA]

Activity. A crude behavioral category to measure overall movement of the animal. (DM)

Ad lib sampling. A method of sampling behavior where animals are chosen opportunistically.

Adaptation. A process of genetic change of a population, owing to natural selection, whereby the average state of a character becomes improved with reference to a specific function, or whereby a population is thought to have become better suited to some feature of its environment. Also, an adaptation: a feature that has become prevalent in a population because of a selective advantage owing to its provision of an improvement in some function. (F)

Adaptationist. One who believes that most characters are due to the action of natural selection; called 'aptation' by SJG; A behavioral biologist who uses the assumption that traits are adaptive to generate testable hypotheses on the fitness consequences of a particular trait. [JA]

Adaptationist Program. The extreme view that all characters are due to the action of natural selection.

Adaptive landscape. Adaptive peak refers to the notion that combinations of alleles at two or more loci are adapted to a specific function or to some feature of the environment such that any deviation from that phenotype results in a reduction in fitness. The notion of adaptive landscapes refers to the fact that there are many such local optima and that animals cannot easily evolve from one to another because of the drop in fitness that is associated with the intervening phenotypes. (see adaptive peak).

Adaptive peak. Genotypes or phenotypes associated with suites of morphological characters that have high fitness with the areas between being short-lived evolutionary phenomena. (SS) That allele frequency, or combination of allele frequencies at two or more loci, at which the mean fitness of a population has a (local) maximum. (F)

Adaptive radiation. Evolutionary divergence by the members of a single phylogenetic line into a number of distinctive types or adaptive forms. (D)

Adaptive significance. The function or survival value of a behavior. (IB)

Adaptive value. The fitness of a trait. [HWS]

Adaptive zone. A set of similar ecological niches occupied by a group of (usually) related species, often constituting a higher taxon. (F)

Adipsia. The lack of thirst. [BB]

Additive effect. Of an allele, its effect on the phenotype, averaged over the variety of genetic combinations in which it occurs. It is said to act additively if its effect is independent of the other alleles it is combined with. (F)

Additive portion of genetic variance, VA. Heritability in the narrow sense is VA divided by the total variance. (CS) This is the portion of genetic variance that is transmitted from one generation to the next.

Adjunctive behavior. Behavior induced by an intermittent reinforcement schedule characteristically displayed during the time interval when reinforcement is highly improbable. [HWS]

Ad libitum (Ad lib). At pleasure, meaning unrestricted access to food or water [HWS]

Adoption. Individuals care for young to whom they are not related. (IB)

Adventitious reward. A reward that is unplanned by the experimenter or not under the experimenter's control. [HWS]

Advergent evolution. When the ancestor of a model has warning coloration and the ancestor of a mimic evolved toward the model so that it came to look like the model.

Advertisement. A form of conspicuous display. Territorial advertisement refers to behavior patterns that serve to attract females and ward off conspecific intruders. (DM)

Aerophagia. The swallowing of air. [HWS]

Aestivation. A period of dormancy during the summer in contrast to hibernation which is winter dormancy. (DM) or in insects called diapause.

Afference. Afferent. Excitation, impulse or information moving from the periphery (over afferent nerve fibers) into the central nervous system. (H) (in contrast to efference).

Afferent inhibition. Inhibition of the IRM resulting in the termination of an animal's response to specific stimuli. However if the stimuli are changed somewhat, then the animal may again respond. (H)

After-discharge. (1) That part of a response that occurs after the termination of the stimulus that elicited it or set the occasion for its occurrence. (2) The term applied to discharges of nerve impulses in efferent neurons that persist in time after the stimulus that set up the discharge is terminated. (V)

Aggregation. A group which is formed by a mutual attraction to a common resource such as a feeding aggregation. (in contrast with social group).

Aggression. A physical act or threat of action by one individual that reduces the freedom or genetic fitness of another. Aggression may refer either to the behavior or to the underlying motivation. (H) There are several different kinds of aggression which almost certainly involve different sorts of controlling mechanisms. (a) **Fear-induced** aggression occurs only in cases where escape has been attempted but it not possible. (b) **Predatory** aggression is elicited during predation. (c) **Male-male** or inter-male aggression is specific to adult breeding males and is generally associated with guarding females. (d) **Irritable** aggression refers to aggression resulting from frustration, deprivation or fear. (e) **Territorial** aggression appears in defense of a territory.

(f) **Maternal** aggression appears in defense of young. (g) **Instrumental** aggression consists of an increase in the tendency for an organism to engage in aggressive behavior when that behavior has been reinforced in the past. (V)

Aggressive behavior. A broad class of behavior that includes both threat and attack behavior. (V)

Aggressive mimicry. Mimicry in which a predator mimics a non-predatory model in order to deceive the operator its prey. [LBC]

Agonistic behavior. Refers to the behavior associated with aggression and escape behavior. (H) A broad class of behavior that includes all attack, threat, appeasement, and flight behavior. (V)

Agonistic buffering. The use of infants by adults to inhibit the aggressive behavior of other adults [LBC]

Aha-Erlebnis. The sudden insightful understanding of a previously unknown relationship. This sudden insight which is not accomplished in a stepwise manner is often associated with the exclamation, "Ah - Ha". (V)

Akinesis. Immobility determined by reflex torpidity resulting from continued contraction of the locomotory muscles, for example, freezing of some animals when in danger. (V)

Alarm call. A sound that warns others of the presence of predators. (IB)

Alarm pheromone. The alarm substance which arouses other members of the social group to defend the nest from enemies or invaders. (H)

Allate. Winged.

Allele. Any of the two or more alternative forms of a gene that occur at the same locus on a chromosome. (mD)

Allelic frequency (or gene frequency). The frequency of a given allele (as a proportion of all alleles at that locus) in a population. (mD)

Allelomimetic behavior. Behavioral activities that have strong components of social facilitation, imitation and group coordination. [HWS]

Allen's rule. The principle that states that in warm-blooded species, the relative size of exposed portions of the body (limbs, tail, ears) decreases with a decrease of mean temperature. (H)

Allochronic. Sympatric species or populations that are reproductively isolated due to mating at different times. (F)

Allochthonous. Formed or occurring elsewhere than in place; of foreign origin (WS)

Allochthonous behavior. (1) Behavior that is not activated by its own drive. (2) Behavior that is activated as a consequence of frustration, or behavior that is activated by some drive other than that which most often controls it. (H) (V) (in contrast to autochthonous)

Allofeed. To feed young that are not the offspring of the feeder; a special case of alloparenting.

Allogrooming. Social grooming. (IB)

Allometric growth. Growth of features during ontogeny at different rates; the growth rate of one part of an organism is different from that of another part or of the body as a whole, usually expressed as an exponential rate. (mM)

Allometry. Changes of shape correlation with increase or decrease in size. (SG) When the growth of one part of the body is disproportional to growth in another part or to overall body size. (see isometry)

Allomone. A chemical substance used in communication among individuals of different species. It evokes a response that is adaptively favorable to the emitter but not to the receiver. [LBC]

Alloparent. "An individual that assists the parents in care of the young" (E.O. Wilson, 1975). To alloparent is to help. See helper.

Allopatric. Allopatry. Pertaining to populations or species that occupy exclusive geographical regions, i.e. they have ranges that do not overlap (cf. sympatric, parapatric). (F)

Allopatric speciation. The formation of new species through geographical isolation of populations. (D)

Allopolyploid. A polyploid in which the chromosomes are derived from more than one species. (F)

Allopreen. To preen an individual other than oneself.

All-or-none. States that once a specific stimulus threshold has been reached, a stimulus can release no more than a certain maximum response value. Below this value, no transmission of excitation occurs. (H)

Allochthonous behavior. (1) Behavior that is not activated by its own drive. (2) Behavior that is activated as a consequence of frustration, or behavior that is activated by some drive other than that which most often controls it. (H) (V) (in contrast to autochthonous)

Allozyme. One of several forms of an enzyme coded for by different alleles at a locus (see isozyme). (F)

Alluvium. A general term for unconsolidated detrital sediment. (WS)

Alpha level. In statistics, the level of significance that is set prior to the initiation of the experiment, usually 0.05.

Alpha-position. In a dominance hierarchy, this is the top position. It suggests that this animal is more likely to have access to resources such as food and females.

Alternation. Switching from one behavior to another that occurs during motivational conflict when there are two competing drives. The modern view is that alternating between two actions is the result of time-sharing.

Alternative strategy (true). When animals of a population are programmed to behave in different ways. (See ESS)

Alternative hypothesis. In statistics the hypothesis accepted when the null hypothesis is rejected [LBC]

Altricial. Refers to the birth of relatively undeveloped young. (SG)

Altruism. Altruistic behavior. Refers to care donated to another individual which increases that individuals' fitness at the expense of the direct fitness of the donor. An action that reduces the individual fitness of the donor and increases the individual fitness of the recipient. (B)

Ambivalent behavior. Behavior that consists of two different, often incomplete reactions occurring simultaneously or in short rapid succession (occurs in conflict situations). (H)

Amble. In the horse a variation of the pace gait that is distinguished by a slight hesitation between the placing of the hooves of the front and rear legs on the same side of the horse. The amble is a slower gait than the pace.

Ambush predator. An animal that awaits its prey and ambushes it rather than stalking it.

Amensalism. In a social interaction where care or resources are involved, a loss to the donor but neutral to the recipient.

Amino acids. The nitrogen-bearing molecules that can be polymerized to form proteins; the basic chemical units of proteins. Life as we know it consists of twenty major varieties. (mD)

Amplexus. The clasping mating behavior of toads or frogs in which the male sits on the female's back as he clasps her sides.

Amplitude of response. A quantitative measure of one dimension of a response. Response magnitude. (V)

Anadipsia. Intense thirst. [HWS]

Anagenesis. Describes directional evolution of a feature over an arbitrarily short segment of a lineage. (cf. phyletic evolution).

Analogy. A resemblance in function and often in appearance, between two structures, physiological processes or behavioral patterns that are due to independent evolution rather than common ancestry (cf. homology). (W)

Analysis of Covariance (ANCOVA). A statistical method for determining whether the functional relationships described by two or more regression equations are the same, i.e. could have come from populations with the same slope; it comprises a combined application of linear regression and analysis of variance and is used when treatments are compared in the presence of accompanying variables which cannot be eliminated or regulated. [LBC]

Analysis of Variance (ANOVA). A statistical technique for partitioning the total variability affecting a set of observations between the possible and statistically independent causes of the variability; useful for examination of sources of uncontrolled variation in experimental situations. [LBC]

Ancestral (see primitive)

Androgen. Generic term for male hormones. (IB)

Anemotaxis. A transverse orientation behavior in which animals orient with respect to wind direction. (HJB)

Aneuploidy. Of a cell or organism, possessing an unbalanced chromosome complement by virtue of an excess or deficiency in number of one or more of the chromosomes compared to the others. (F)

Angst. An effect or feeling associated with oppression or persisting despair. May be associated with physical symptoms such as defecation, urination, sweating of the palms etc. (H)

Anisogamy. Refers to condition in which the male and female gametes are of different sizes.

Ankle attacks. Cats commonly attack the ankles of someone entering the room or any moving object. The easiest way to stop these attacks is to provide the cat with movable toys. [BB]

Anorexia. Occasional failure to eat is common in animals and may be caused by unpalatable food, nausea or individual variation in appetite. Long-term anorexia is caused by lesions in the hypothalamus or medical problem that act on the GI system or brain [BB]

Anoxic. Pertaining to the absence of uncombined molecular oxygen. (WS)

Antennation. Touching with the antennae.

Anthropogenic. Caused or produced through the agency of humans. [LBC]

Anthropomorphism. Refers to the giving of human attributes to animals. Critical anthropomorphism refers to using anthropomorphisms to think through or explain a problem.

Anticipatory action. See intention movement.

Anticodon. The triplet of nucleotides in a tRNA molecule which associate by complementary base pairing with the codon in the mRNA during translation. (S)

Anting. An innate behavior in several bird species that serves to spread the poisonous secretions of ants over the plumage. Some species sit down directly on an ant hill whereas others hold ants in their beak and rub them over their plumage. (H)

Antiphonal singing. A type of duetting in which the birds sing with alternated calls and responses. (IB)

Anti-predator behavior. (1) Behavior patterns that have evolved as defense mechanisms against predators. (H) (2) Generalized term for all naturally occurring mechanisms for escaping a predator. This includes protective coloration, as well as a variety of behavioral adaptations such as death feigning, distraction displays, threat and outright defense. (V)

Aphrodisiac. A chemical which when produced makes a female more likely to mate with the sender.

Apomixis. Parthenogenetic reproduction in which an individual develops from an unfertilized egg or somatic cell. (F)

Apomorphic. Apomorphy. A derived character state based upon comparison with the ancestral state (see pleisomorphic).

Aposematic. Coloration or other features that advertises noxious properties; warning coloration. (F)

Aposematic behavior. (1) Behavior patterns which neutralize or redirect the aggressive attacks of conspecifics and often serve to change the "mood" of the attacker. (2) Those behaviors of an animal (exclusive of flight) that, when they occur, terminate attack by another animal of the same species. (V)

Apostatic selection. Differential survival of one morph due to the action of predators who forms learned associations between particular visual images and acceptable food.

Appeasement. Behavior that serves to inhibit or reduce aggression between members of the same species often in situations where escape is impossible or disadvantageous. (DM)

Appetite. Refers to those physiological changes and cognitive events that are evoked by the stimulus properties of foods. Hunger on the other hand refers to the physiological changes and cognitive events which are the consequence of prolonged fasting. (DM)

Appetitive behavior. (a) Specific behavior in which an individual searches for a releasing stimulus situation which leads to the desired consummatory act by means of the releasing mechanism. Often used loosely to describe the wandering behavior that often precedes a consummatory act. (H) (2) A term applied to characterize, in terms of an inferred or anticipated (by the ethologist) consummatory act, the behavior of an animal that is not at rest or "doing nothing". (V) Traditionally this refers to the active, goal-seeking and exploratory phase of behavior that precedes the more stereotyped consummatory behavior that an animal exhibits when it reaches its goal. Now regarded as a conceptually vague notion which is difficult to define operationally. (DM) Appetence for aggression would refer to an animal seeking out a stimulus that would elicit aggressive behavior.

Applied ethology. A branch of behavior study concerned with animal species that are of direct practical interest to people, emphasizing the possibilities for practical application that are within ethology's domain. As most of the species with which people deal directly are other domestic animals or zoo animals, applied ethology more or less divides between veterinary ethology and zoo biology. (IB)

Approach-withdrawal theory. A view of behavioral development put forward by Schneirla (1965). According to the theory, when animals begin life they are capable only of forced movements; intense stimulation causes withdrawal, and mild stimulation causes approach. By interacting with its environment, the organism builds up this base of qualitatively distinct levels of behavioral capacity, such as discrimination, motivational control, and hypothesis formation. (IB)

Approximation conditioning or shaping conditioning. If the experimenter wants to condition a highly improbable (infrequent) operant response (one that will not occur and, hence, cannot be reinforced, except rarely such as bar pressing), the experimenter may shorten the tie before the subject emits the response by reinforcing other responses that are successively more like the response to be conditioned. (V)

Apterous. Wingless.

Arboreal. Living in trees; adapted to life in trees. [LBC]

Arena display. See Lek.

Area effect. Abrupt geographic change in morph frequencies between two relatively uniform populations or series of populations living in an apparently uniform habitat.

Area Effects Speciation A kind of parapatric speciation in which reproductive isolation develops between two populations that show area effects.

Arenicolous. Living in sand. [LBC]

Arms race (evolutionary). The notion that animals are constantly evolving adaptations to counter the adaptations of their predators, competitors or parasites. Each evolutionary advance by one party is countered by an advance by the other. An arms race is 'won' when one party drives the other extinct.

Arousal. Refers to several different concepts: (1) the original usage in physiology distinguishing states of sleep and wakefulness, (2) distinguishing levels of responsiveness from periods when the animal is willing to do things to periods when the animal does not respond except with high levels of stimulation, (3) distinguishing levels of activity and the kinds of behavior being performed (e.g. grooming low level, fighting high level), (4) distinguishing the degree of reflex preparation for exertion or immobility and (5) the amount of sensory input which the central nervous system is prepared to accept at a particular time. (DM)

Arrhenotoky. (See haplodiploidy)

Artenkreis. Groups of species that replace one another geographically (as distinct from Rassen Kreis). (H)

Artificial selection. The process of choosing those animals that will reproduce in a given population on the basis of a given trait or traits (choosing done by humans). (BC)

ASAB. Association for the Study of Animal Behavior (European national professional organization)

Asexual Reproduction. Reproduction without the fusion of gametes. [LBC]

Assessment. Decisions (e.g. to fight or not, to mate or not) based on the demonstrated attributes of another organism. The process by which animals evaluate the attributes of another individual, such as their fighting ability. This may involve pushing contests or bouts of high energy threat displays or outright fights. (HJB)

Association. A process in learning, particularly in the type of situation originally described by Pavlov as classical conditioning. (DM)

Assortative mating. Nonrandom mating on the basis of phenotype; usually used for positive assortative mating, the propensity to mate with others of like phenotypes. (F) but may be negative assortative mating as in the rare male effect.

Asymmetry. Any incomplete identity between the two sides of the body, e.g. arms are of different lengths. [HWS]

Atavism. Throwback inheritance. The occasional occurrence in individuals of a species of characteristics of phylogenetically ancestral form.

Attachment. A tie between an animal and some place, object or social companion. (IB)

Attack behavior. A broad response class including those behavior patterns of an animal that, when carried to completion, bring to bear one or more of the animal's effectors on the body surface of a second animal in such a way that injury of the second animal will occur if the behavior continues. (V)

Attendant. A bird attending a nest, including parents and helpers (Down, 1980)

Attention. The notion that not all portions of incoming signals are detected equally and that by attending to one, the animal is less likely to be able to recall what occurred in the second. (DM)

Attenuation. The drop in intensity of a sound with distance.

Aunt. A female that assists a dam providing care for young. In the wild the aunt is normally a close relative. [HWS]

Autapomorphy. A unique apomorphy; not helpful in determining species' taxonomic relationships [Wil]

Autochthonous. Formed or occurring in the place where found (opposite of allochthonous). (WS)
Behavior that is activated by its own drive. (V)

Autogamy. Formation of a diploid nucleus by the union of male and female gametes in the same individual; a process of self-fertilization. (M)

Automimicry. (1) In behavior the limitation by one sex or life stage of another sex or life stage of the same species. (2) In studies of color mimicry, automimicry refers to the situation in which some individuals of a species store poisonous compounds (host) whereas others do not (mimic). When there is a palatability spectrum within a species, the more palatable individuals within a species protect the less palatable individuals.

Autonomic nervous system. A division of the vertebrate nervous system serving internal organs such as the heart, blood vessels, lungs, intestines and also certain glands. The sympathetic nerve pathways have an emergency function and become active under stress. They have the effect of accelerating heart rate, dilating air passages to the lungs, increasing the blood supply to the muscles, reducing the activity of the intestines. The parasympathetic pathways serve a recuperative function restoring the blood supply to normal and countering the effects of the sympathetic activity. (DM) May be the origin for some displays.

Autonomy. The reflexive self removal of a body part, such as the tail breaking of a lizard.

Autopolyploid. A polyploid that originates through multiplying of a single set of chromosomes of the same species (cf. allopolyploidy). (mD)

Autoshaping. A type of conditioning that occurs simply because of repeated exposure to certain stimulus contingencies. Dogs and cats quickly learn to associate the noise of a can opener with presentation of food so they come running and start drooling with the sound alone. [BB]

Autosome. A chromosome other than a sex chromosome. (M)

Auxiliary. A helper. See discussion under **helper**.

Aversive stimulus. A stimulus which, if it is applied following the occurrence of a response, decreases the strength of that response on later occurrences. (V)

Avoidance. Reactions that allow animals to escape from actual or potential dangers in the environment. (DM)

Axon. The portion of a nerve cell through which signals are conducted away from the cell (see dendrite).

Azimuth. Horizontal direction with respect to some reference point. The sun's azimuth is its clockwise angle with respect to due south. (IB)

B. The gain in fitness associated with performing an act.

b. The individual birth rate, the number of female offspring one female will have per unit of time. (WB)

Backcross. A cross between a heterozygote and a corresponding homozygote (AA or aa) (BC)

Back mutation. A second mutation that causes the allele to revert back to the original condition. (B)

Badge of status. A term introduced by Dawkins and Krebs (1978) for features of appearance that indicate ability to maintain control of a resource, such as territory (See Resource-Holding Potential). For example, the dominance status of male Harris's sparrows (*Zonotrichia querula*) correlates with the area of black feathers below the beak. When the size of this bib was experimentally enlarged on some subordinate males, higher-ranking males attacked them more, showing that the wearers of badges may be tested to see whether the advertised status is merited. (IB)

Balanced polymorphism. Two or more alleles are maintained in a population by frequency-dependent selection or heterozygous advantage.

Balancing selection. Any of several forms of natural selection leading to a balanced polymorphism. (DO)

Baldwin effect. The now outmoded idea that in some instances behavioral changes could precede some more fixed evolutionary change and create a climate favoring the latter. (B)

Ballistic behavior. See Open-loop behavior.

Ballooning. The dispersal through the air of silk-producing spiders and insects suspended on silk threads.

Bark. A short, sharp vocalization produced with an open mouth as a single sound or short series of repeated sounds. [HWS]

Baroreceptor. A sensory receptor activated by changes in barometric pressure. [HWS]

Basic rank. The paired terms "basic rank" and "dependent rank" are used mainly in the primate literature to signify that the positions held by two individuals in a rank order may differ according to the presence or absence of other social influences. Basic rank is the rank relationship between

two animals in situations where other group members do not interfere; dependent rank is their rank status as influenced by other group members or the group as a whole. (IB)

Basking. A behavior of reptiles and other species in which they sit out in the sun, often extending legs or feet so as to increase solar radiation.

Batesian mimicry. Mimicry in which a harmless or tasty species superficially resembles a dangerous or distasteful model species. (E)

Bathing. Maintenance behavior associated with dispersing water or dust through the fur or feathers so as to clean and/or remove parasites from the body surface. (HJB)

Beau Geste hypothesis. An explanation for the evolution of multiple song types. The notion is that by singing many songs intruders will think there is more than one individual present (see vocal mimicry).

Bee dances. A collective term referring to the various orientation behavior patterns of the honeybee which communicate distance and direction of food to hivemates.

Behavior, Behaviour. (1) The whole complex of observable, recordable, or measurable activities of a living animal. These include movements of the skeletal, cardiac, or smooth muscles, production of sound, discharge of electric organs, movements of cilia, contraction or expansion of chromatophores, glandular secretion, and changes in body chemistry (including those producing luminescence) as they are concerned in the animal's interaction with its environment. (2) Any parts of behavior that are recurrently identifiable and classifiable by the observer. (H) ("Behaviors" refer to behavior patterns)

Behavior chain. A stereotyped sequence of stimuli and responses that can be observed repeatedly in an animal, with only minor variations in the ordinal position of each stimulus and response. (V)

Behavioral ecology. A field of study which emphasizes the adaptiveness of behavior. (HJB) The study of the adaptive value of behavioral attributes of individuals in solving environmental obstacles to reproduction. [JA]

Behavioral mimicry or ethomimicry. Imitation of behavioral rather than morphological characteristics of other animals.

Behavior modification. Behavior modification refers to any of several techniques used to modify or eliminate a particular behavior, e.g. desensitization, extinction [BB]

Behavioral pattern. A set of responses statistically organized in time, i.e., associated together and manifesting some degree of stereotypy in the temporal sequence in which they occur. (V)

Behavioral physiology. That part of ethology that deals with the physiology of behavior, and that part of physiology that deals with behavior. It includes neuroethology and behavioral endocrinology. (IB)

Behavioral repertoire. The set of behavior patterns characteristic either of an entire species or of a single member of a species. (V) The totality of behavior patterns characteristic of a species. (IB)

Behaviorism. A school of psychology founded by the American J.B. Watson (1913) and having its most powerful influence in the United States. Its basic and revolutionary premise was that psychology should be regarded as the science of behavior as opposed to the science of mental life,

as William James believed. This implied that all mentalistic concepts were to be eschewed, unless they could be redefined in terms of observable behavior and the ascertainable or contrived circumstances of its occurrence. All psychological concepts must be reducible to those terms. (IB)

Behaviors. A vague term that usually means behavioral patterns.

Behaviorist. A scientist who investigates the behavior of animals objectively and who attempts to relate his observations together in a theoretical system that does not include concepts borrowed from introspection and mental philosophy. More specifically, a psychologist who studies behaviorism. (V)

Bergmann's rule. Within a polytypic warm-blooded species, the body size of a subspecies usually increases with decreasing mean temperatures of its habitat. (H)

Best-of-a-bad-job strategy. Conditional strategy of individuals where they behave according to a programmed rule making the best of the situation in which they find themselves.

Bias. A systematic error in sampling inherent in the sampling method.

Bill wiping. A bird rubs its bill on the substrate in a characteristic manner. In song birds the sides of the bill are rubbed alternatively on alternate sides of a branch whereas in species such as chickens the sides of the bill are wiped alternately on the substrate.

Billing. In birds which maintain permanent pair bonds, mutual beak contact of the pair partners is common. The bills are either crossed or the bill of the arriving partner is grasped by the other as in food begging of the young.

Bimodal population. A population containing one or more characteristics, the measurements of which show two peaks of relative frequency. (D)

Bioacoustics. The study of vocalizations and sound production in animals.

Biogenetic law. Haeckel's term for the principle that ontogeny recapitulates phylogeny. (SG)

Biogeography. Branch of biology that deals with the geographic distribution of plants and animals. (K)

Biological clock. A physiological mechanism for measuring time or maintaining endogenous rhythms.

Biological species concept. A concept of the species category stressing reproductive isolation and the possession of a genetic program effecting such isolation. (M) A concept of the category species based on the reproductive isolation of the constituent population from other species.

Bipolar. Neurons that conduct in both directions.

Bivoltine. A life-history pattern with two generations in one year. Partially bivoltine refers to a life-history pattern in which animals sometimes produce offspring that overwinter (i.e. one generation per year) and sometimes produce offspring that emerge later in the same season (i.e. bivoltine).

Bivouac. The mass of army ants within which the queen and brood find refuge.

Black box approach. An approach to the study of mechanisms that results in developing hypotheses about internal patterns and structure based on altering sensory (or other) input and observing the consequent changes in behavior.

Blending inheritance. Before the time of Mendel, the belief that inheritance was not particulate.

Block diagram. A diagram of a system in which arrows represent variables and blocks represent parameters of the system.

Blue-green algae. Cyanobacteria. (WS)

Bond. social attachment; a specific dependence relationship between two or more individuals. (IB)

Bootstrap method. A technique whereby an unknown distribution is estimated by repeated sampling from a sample distribution (sampling using the computer) to arrive at confidence intervals for that distribution with which your observed results can be then compared.

Boredom. Prolonged exposure to repetitive sights, sounds, etc., leads to impaired performance in tasks which involve attention to stimuli. It is not possible to know whether animals have the same subjective experience as humans because it cannot be measured and thus this term should be avoided when referring to animals. (DM)

Boring. Refers to organisms capable of penetrating solid substrate by mechanical scraping or chemical dissolution.

Bottleneck effect. Occurrence of genetic reorganization of a population through genetic drift which is caused by a drastic decrease in abundance. (mD)

Bout. A bout of behavior occurs when an action is repeated several times in quick succession, with longer intervals between, i.e. inter-bout intervals.

Bower. Display structure of bower birds. (IB) construction by males for mate attraction.

Brachiation, brachiating. Progression through trees by swinging from branch to branch with the forelimbs.

Bradytely. Evolving at a relatively slow rate.

Breathing. The movement of air in and out of lungs and thus a part of the total function of gas exchange. (DM)

Breeding population size. The number of individuals in a population actually involved in the reproduction of a given generation. (D)

Bridling. The post-copulatory display of a male anatid duck. (H)

Broadcast promiscuity. A breeding system in which the gametes are released into the environment and fertilized by males in the surrounding water.

Broken-wing display. The predator is distracted by the adult bird which looks as though it is feigning some locomotor impairment such as limping or wing injury. The predator is led some

distance from the nest or young, then the adult stops feigning and takes a circuitous route back. (see distraction display)

Brontophobia. fear of thunder [BB]

Brood parasitism. The laying of eggs in the nest of another individual either a conspecific or a heterospecific and then allowing the host to rear them. Also called "cuckoo behavior."

Brood patches. In birds there are areas of ventral skin that become defeathered, vascularized and edematous during incubation.

Broodiness. A part of maternal behavior directed specifically to the hatchlings, most commonly associated with birds. The behavior includes protecting and covering the chicks. [BB]

Brooding. In birds, the parents sitting or crouching over young to provide warmth and cover. (IB)

Bruce effect. A condition in which the presence of an unfamiliar male prevents the implantation of a fertilized egg or induces abortion. (JK)

Buller steer syndrome. Bullers are steers that stand for mounting by other steers called riders. The behavior can cause injuries or exhaustion to the animals being ridden. May be related to crowded conditions stress and hormone implantation. [BB]

Bulling. Mounting and chin-pressing of a cow by another cow, usually when the instigator is close to or in estrus. [HWS]

Burying food. Domestic carnivores commonly bury food, a behavior commonly found in the wild to keep the food away from scavengers and conspecifics. [BB]

Butting. A distance-increasing behavior shown by ungulates as they aggressively strike with the head. [BB]

By-product mutualism. A mutualism in which benefit to neighbors is an incidental byproduct of actions taken by the donor for its own benefit. Reciprocation is not required to maintain byproduct mutualism, as it is for score-keeping mutualisms.

C. Opportunity cost. The gain in fitness from performing the alternative act. (See Hamilton's Rule).

Caching. The laying by of food for use during times of insufficient supply. Also called food storage.

Cainism. The killing of siblings, fratricide, siblicide.

Call. Vocalization that is simpler than passerine song.

Camouflage. A form of visual deception by means of which an animal can elude predators or a predator may lurk undetected awaiting a suitable prey. (DM)

Cambrian. The earliest geologic period of the Paleozoic Era. 570-504 my ago. (WS)

Canalization. A property of developmental pathways whereby a standard phenotype is achieved in spite of genetic or environmental disturbances. (M) The operation of internal factors during development that reduce the effect of perturbing influences, thereby constraining variation in the phenotype around one or more modes. (F)

Canalizing selection. The selection of genes that would stabilize the developmental pathways so as to make the phenotype less susceptible to the effects of genetic or environmental disturbances. (M)

Cannibalism. The consumption of conspecifics as food.

Care-giving behavior. Behavior of guarding and protecting young, not necessarily your own.

Carrying capacity. K. The largest population size that can be maintained by an environment. (SG)

Caste. Found in social insects, where some individuals do all the reproducing (queens and kings) whereas others act as non-reproductive workers. In ants caste refers to morphological differences among workers. (HJB)

Caste polyethism. The division of labor roles within a social insect colony.

Catastrophism. Cuvier's explanation of the successive replacements of fossil faunas as the result of geological catastrophes. (mM)

Category. In taxonomy, one of the ranks (e.g., genus, family) of classification. See Taxon.

Caterwauling. Vocalization by cats, particularly intact tomcats to advertise their territory to potential mates and to warn intruders away. [BB]

Causal factor space. The array of motivational variables that influence the likelihood that an action will be performed.

Cenozoic. Most recent era of the Phanerozoic Eon. 65-0 my ago (WS)

Center. (a) a locus in the nervous system characterized by the presence of a number of cell bodies and synapses. the excitation of which by appropriately specified electrical stimulation, may yield discrete motor or autonomic behavior patterns and experimental destruction of which is followed by the disappearance or gross modification of discrete motor or autonomic behavior pattern. (2) A functionally coordinated, but not necessarily localized, group of neural structures having the properties of a center. (3) a hypothetical neural structure, or place or set of places in the central nervous system, of unspecified anatomical properties, which is presumed to act as a unit upon excitation by another such place or other such places by sending nerve impulses that govern the occurrence of some innate response. (V)

Central Pattern Generator. A group of cells in the central nervous system that can produce the particular pattern of signals needed to cause a fully functional behavioral pattern. [JA]

Centrifugal speciation. (see geographic speciation).

Centromere. The portion of a chromosome, usually greatly restricted in length, to which spindle fibers are attached in cell division. (E)

Chain reflex. Pavlov maintained that all behavior could be explained as a sequence of conditioned and unconditioned reflexes and that complex behavioral responses were simply put together in chains. (H)

Chain of response. Behavior sequence in which each movement or activity brings an animal into a situation where the next action pattern is evoked. (DM)

Challenge display. A high intensity aggressive display performed by a male to a conspecific male. [LBC]

Change of function. An evolutionary phenomenon whereby an organ which ceases its original function may take over a new function. (H)

Character. An attribute of a member of a population or taxon by which it differs from a member of a different group or taxon (M), more generally a feature or trait. (F)

Character state. One of several variant conditions of a character. (F)

Character displacement. A divergence of equivalent characters in sympatric species resulting from the selective effects of competition. (M)

Character polarity. The direction of character state change; determined by outgroup comparison [Wil]

Chemoreceptors. Sensory cells or sense organs for the perception of chemical stimuli; primarily the cells or organs of smell and taste.

Chemotaxis. An orientational reaction by free-moving animals induced by a chemical stimulus, smell or taste. (V)

Chiasma. (plural: chiasmata). An attachment between homologous chromosomes in mitosis or meiosis; thought to be the point where physical exchanges between homologues occur, i.e. crossing-over. (BC)

Chimera. An individual whose cells are not all of the same genotype. (BC)

Chin raising. Epigamic behavior in ducks in which both partners face one another and together raise the bill angle above the horizontal. (H)

Choice (as in female choice). There are two types of choice, active and passive. In active choice the female compares the alternatives and acts upon that information. Passive choice, on the other hand, occurs simply when females mate non-randomly. They may be mating with the product of male-male competition and while this does not constitute active choice on her part this kind of choice is the product of selection and in an evolutionary sense constitutes choice.

Choice points. (1) that position in a T-maze, or other maze, or on a discrimination apparatus, from which it is possible for the animal to give only one of two or more alternative responses. (2) In a sequence of behavior, the point where alternative actions can occur. (V)

Choice test. (1) A type of tests for determining the learning capacity or sensory abilities of animals. Certain colors, forms, patterns, etc. of objects are presented and the animal must make a choice between the correct one, for which it is rewarded, and the wrong one for which it is given no reward or punished. (2) A test of the decision-making rules of individuals. (3) A method for

determining the social preferences of animals and for investigating their learning and discrimination capacities and the releasing and directing effects of stimuli. A choice test presents the experimental animal with two or more objects or live animals, for example on a selection platform or at opposite ends of a multipartitioned cage or aquarium. The animal's reactions or the time it spends in the vicinity of each option are recorded. As a rule the choice objects are presented together (simultaneous choice test), but sometimes they are presented one after the other (successive choice test). The results of simultaneous and successive tests do not always agree. When presented with comparable calls of neighboring adults and parents, chicks recognized their parents' calls in simultaneous presentations, but showed no discrimination in successive presentations. In the natural situation chicks of this age are better off with their parents, but if they get separated from their parents, their only hope of survival is to be adopted into another family, so indiscriminate responsiveness is then the more adaptive course. (IB)

Choking. A display pattern of gulls in which the members of a pair lower their breasts, bend the legs, nod their heads and rhythmically jerk the head as if to peck at the ground, although they do not reach the ground.

Chorusing. Communal song; song of aggregated animals.

Chromatid. A visible subdivision of a chromosome having but one centromere (or behaving as if the centromere were undivided); a half chromosome. (E)

Chromosome. A threadlike structure present in the nucleus of cells and containing genes in linear arrangements. (AV)

Chronospecies. Segments of a single lineage, between which there has been gradual evolutionary change so that the descendants are morphologically distinctive but for which any subdivision within the gradational series would be arbitrary. (AV) A segment of an evolving lineage preserved in the fossil record, that differs enough from earlier or later members of the lineage to be given a different binomial (name). Not equivalent to biological species. (F)

Circadian rhythm. The daily pattern of activity of a cycle that is approximately one day in length expressed independent of environmental changes. [JA]

Circannual rhythm. Changes in behavior that recur at 12-month intervals that expresses itself independent of environmental changes. [JA]

Circular overlap. The phenomenon in which a chain of contiguous and intergrading populations of a species, where the terminal links overlap with each other and the populations behave like good (non-interbreeding) species. (M)

Cis. Of two genetic elements, located on the same individual chromosome rather than on homologous chromosomes; of gene action, influence of one genetic element on the function or expression of another genetic element on the same individual chromosome (see trans). (F)

Cistron. A DNA fragment or portion that specifies or codes for a particular polypeptide. (S)

Clade. A species or set of species representing a distinct branch of a phylogenetic tree, i.e. descended from a common ancestor. (W)

Cladism. School of taxonomy that bases its classification or evidence on common ancestry through shared, derived characters.

Cladistic. Pertaining to branching patterns; a cladistic classification classifies organisms on the basis of the historical sequences by which they have diverged from common ancestors. (F)

Cladogenesis. The splitting or branching of one lineage into two during evolution.

Cladogram. A phylogenetic tree emphasizing branching patterns and when they occur (see phenogram). A diagram showing the branching points of divergence over the course of evolution.

Clandestine evolution. Evolutionary change introduced and developed in juvenile stages and incorporated into descendant adult stages by paedomorphosis. Since juvenile stages fossilize so rarely, these evolutionary events go unnoticed until they are promoted to a descendant adult. (SG)

Claspers. Structures found in frogs and toads, sharks, horseshoe crabs, some insects and many other species for holding on to the female.

Classical conditioning. The experimental procedure of repeatedly presenting the animal with a stimulus (unconditioned stimulus or US) of some reflex contiguously or almost contiguously in time with a neutral stimulus (conditioned stimulus or CS). Conditioning is said to have occurred if, and only if, a response (conditioned response or CR) similar to, but not necessarily identical with, that of the reflex can later be elicited by the initially indifferent stimulus (CS). (V)

Claw-sharpening. Cats claw objects as a part of grooming, marking and stretching. The behavior of extending foreclaws into soft wood or fabric helps remove fragments of claw that are being shed and keeps the claws sharp. There is also an olfactory message left by sweat glands on the feet and a visual cue left by changes in the surface with repeated claw-sharpening bouts at the same location. [BB]

Claw-waving display. In fiddler crabs the large cheliped is used in threatening conspecifics as well as attracting females. Also found in other crab species.

Cleaner fish mimic. The sabertoothed blenny has copied the form, coloration and locomotory behavior of the true cleaner fish and profits from the mimicry by biting small pieces out of the skin, fins and gills of the fish expecting to be cleaned.

Cleaning symbiosis. An interspecific, mutualistic interaction in which animals are specialized for removing parasites and necrotic tissue from the body surface of another species. The evolution of cleaning is associated with a set of signals which permits interspecific communication. Most common in fish and shrimp. A form of association between animals of different species that benefits them both. The requirements of one partner is to be rid of ectoparasites; for the other the ectoparasites constitute an important or even the sole source of food. (IB)

Cleistogamy. Self-pollination within a flower that does not open. (F)

Cleptoparasitism. In entomology this refers to brood parasitism. A parasitic fly for example, lays its egg on the provisions of a wasp. The fly larvae develop more quickly and either eat the host larva or out compete it. (HJB)

Clever Hans. The horse named Clever Hans was reputed to be able to do arithmetic; when presented with a sum written on a blackboard, it gave the answer by tapping out the number with its foot. Tests proved that the animal was really responding to subtle cues, unwittingly given by the questioner, that signaled when to stop tapping. Ever since this demonstration of how unconscious cueing can affect an experiment on animal intelligence, behavioral scientists have been alert to the possibility and tried to exclude it. Some of the recent work on language learning

in apes has been criticized on the grounds that a Clever Hans effect might have been involved. (IB)

Climax community. A community capable of perpetuation under the prevailing climatic and edaphic conditions.

Clinal Speciation. A kind of parapatric speciation in which reproductive isolation develops along a cline.

Clinch position. Body position of two fighting adversaries characterized by mutual insertion of the head between the hind legs of the opponent.

Cline. A gradual change in an allele frequency or in the mean of a character over a geographic transect. (F)

Clock-shift experiment. A way of studying compass reactions of animals when those reactions are time compensated. The idea is that by altering the time of day during which the animal is active (i.e. giving the animal jet lag), you can make predictions about which stimuli the animal is responding to. For example, if the animal is using a sun compass and it is always fed in the south end of its cage, then if its time clock is shifted back by three hours, the animal will go to what it thinks is the south end of the cage, i.e. at noon it will go toward the sun, but since it is clock-shifted by three hours it will actually go to the west of south by 45 degrees (15 degrees per hour).

Clone. A lineage of individuals produced asexually by parthenogenesis or vegetative reproduction by mitotic division. (F)

Closed-loop behavior. Behavior that is performed with feedback control. (See feedback)

Closed population. A population with no genetic input other than by mutation, i.e. with no gene flow (mM).

Clutch. A set of eggs laid on consecutive days. [HWS]

Coadaptation. The harmonic, epistatic interactions of genes brought together by natural selection. (M)

Coacervates. Aggregates of varying degrees of complexity resulting from the interaction of two or more colloids. (E)

Coarse grained environment. The environment experienced by an organism with poor homeostatic mechanisms, low behavioral plasticity and mobility; experienced as sets of alternative, disconnected conditions. [LBC]

Codon. A group of three nucleotides that code for an amino acid. (S)

Coefficient of genetic determination. (CGD). Heritability in the broad sense.

$$V_T = V_G + V_E + V_I \quad \text{CGD} = \frac{V_G}{V_T}$$

Coefficient of relatedness. A measure of genes shared as a result of having a common ancestor; the probability that an allele present in one individual will be present in a relative; the proportion of the total genotype of one individual present in the other as a result of shared ancestry. [JA]

Coefficient of variation. The standard deviation divided by the mean, multiplied by 100. (F) Used for comparing variation in a character when the means are different.

Coevolution. The interdependent evolution of two or more species having an obvious ecological relationship [LBC]

Cognition. (1) A hypothetical stimulus-stimulus association or perceptual organization postulated to account for expectancies. (V) (2) As used in animal behavior studies of cognition generally refer to mental processes that are presumed to be occurring within the animal, but which cannot be directly observed. (DM)

Cognitive ethology. That part of ethology having to do with animal cognition. (IB)

Cognitive map. An internal representation of the layout of an area of the environment. Tolman argued that such representation is implied by the ways rats can run mazes when presented with shortcut or detours they have not previously taken. (IB)

Coelom. A "true" body cavity in animals, filled with fluid, lined with mesoderm and communicating with the exterior by special ducts. (AV)

Coevolution. The evolution of two or more species closely associated ecologically, with each exerting significant selective pressures on the other.

Cognition. Cognition applies to an individual's mental functions including the ability to learn, remember and think. [BB]

Cohort. Those members of a population that are of the same age. (F)

Coital lock. Powerful contraction of the vulva around the bulb of an inserted penis which temporarily prevents separation of copulating partners, e.g. in copulating dogs. [HWS]

Collateral kin. Kin who lie on different branches of a genealogy below a bifurcation, as opposed to lineal kin, who lie on the same line of descent or branch. Parents and offspring are lineal kin. Siblings are collateral kin of each other.

Colloid. A dispersion of one substance within another, having properties of both a solution and a suspension. (E)

Colony. In biology, a congregation of individuals of the same species, "congregation" here carrying no implication about the nature of the cohesion. The individual members may be joined together as branching growth, in which case their individuality may appear to be merged in the whole, as in many of the marine animal forms described as colonies (for example, hydroid colonies, Portuguese men-of-war, sea pens). They may be held together by gelatinous secretions, as in the colonies of many algae. And colonies can be free-living, as the breeding colonies of many birds are, and the societies (sometimes described as colonies) of ants and termites, and sedentary groups of spiders. In the case of insects, however, because of the degree of mutual dependence between individuals, the question can be raised of the extent to which they have true individuality. (IB)

Color vision. Refers to the ability of animals to detect the wavelengths of light as opposed to their relative shades of gray. (DM)

Comfort behavior. (see maintenance activity)

Comfort movements. (see maintenance activity)

Command neuron. A cell in the CNA that controls the activation of a behavior.

Commensalism. An ecological relationship between species in which one is benefited but the other is little affected.

Communal breeding. A system of breeding that is characterized by the normal presence of helpers at some or all nests. Often this results in the presence of three or more birds attending the young at a given nest, though this need not be true when a parent is missing. Brood capture, in which a parent takes over the care of young not its own by forcing the real parents to abandon them, which happens in some waterfowl, is excluded by tradition though not by the above definition. Cases in which individuals care for young not their own as a result of deception through intraspecific or interspecific brood parasitism are also excluded by tradition. In these cases the actual parents (the parasites) do not care for their own young. In this way brood parasitism differs from communal (cooperative) breeding. (Brown 1987)

Communal courtship. Displays associated with group mating.

Communal nesting. (1) Vehrencamp (1977, 1978) chose to refer to joint nesting as communal nesting. Her usage was confusing because the term communal breeding had been widely used for a different meaning altogether and still is (see communal breeding). (2) In bees and wasps, communal nesting refers to several adult females sharing a common nest, each laying her own eggs.

Communication. (1) Signal transmission and information transmission and information transfer as a prerequisite of social behavior. (2) An animal is said to have communicated with another animal when it can be shown to have influenced its behavior. (3) Animal A is said to have communicated with B when A's behavior manipulates B's sense organs in such a way that B's behavior is changed. (DM) The cooperative transfer of information from a signaler to a receiver. [JA]

Community. The group of organisms found in a particular place. (E)

Comparative method. A procedure for testing hypotheses on the adaptive value of a trait using disciplined comparisons among species. [JA]

Comparative study. In ethology comparative studies are those which compare behavior among two or more species and allow one to determine either behavioral homologies or convergence. (DM)

Compass. An animal is said to have a compass when it is able to travel in and maintain a fixed direction.

Compass reactions. Transverse orientation at a temporarily fixed angle to the direction of the external stimulus.

Competition. Use of the same limited resources by two or more organisms. (E)

Competitive exclusion. The principle that no two species can coexist at the same locality if ecological requirements are identical (Gauss's rule). (M)

Concerted evolution. Maintenance of a homogeneous nucleotide sequence among the members of a gene family (q.v.), which sequence evolves over time. (F)

Concorde fallacy. The principle that the amount of time and energy an animal expends on a project in the past dictates its future investment. (IB)

Conditional strategy. A set of rules that enables individuals to exhibit different tactics under different environmental conditions; the capacity to be behaviorally flexible. [JA] When the behavior shown by an animal depends on circumstances, such as age or size. [HJB]

Conditioned response. A response which appears or is modified as a consequence of conditioning. Subclasses of the Pavlovian CR include (a) backward conditioned response, the conditioned response that is set up by classical conditioning when the unconditioned stimulus (US) precedes the conditioned stimulus (CS). (b) Delayed conditioned response, the conditioned response, the conditioned response that is set up by classical conditioning when the interval between the onset (or termination) of the CS and the onset of the US ranges from zero to the interval between the onset (or termination) of the CS and the onset of the US ranges from zero to several seconds, and when CS and US overlap in time. (d) Trace conditioned responses, the conditioned response that is set up by classical conditioning when an interval of several seconds intervenes between the termination of CS and the onset of US. (V)

Conditioned stimulus (CS). In classical conditioning a stimulus which originally does not evoke any response similar to the unconditioned response, but which during conditioning acquires the property of eliciting this response or a similar one. The original neutral stimulus. (V)

Conditioning. (1) The generic name for the empirical concepts defined procedurally below. The construction of associations or conditioned reflexes. During conditioning the unconditioned stimulus is replaced by the conditioned stimulus as the factor that releases the given response. (2) The hypothetical production of a change in the nervous system presumed to occur with and to underlie conditioning. (V)

Conflict (motivational). (1) A term applied when the stimuli for two incompatible responses are presented simultaneously under conditions in which either, presented alone, would yield a response. (2) The state of the animal when two drives associated with incompatible behaviors are equally or nearly equally strong. Conflict behavior may result in a number of responses including alternation, redirected and displacement behavior. (3) Denotes a state of motivation in which tendencies to perform more than one activity are simultaneously expressed. At any particular moment the animal has many incipient tendencies but by a process of decision making one of these becomes dominant, i.e., the consummatory behavior. (DM)

Congeneric. Species belonging to the same genus.

Consanguinity. Two or more individuals are said to be consanguineous if they have a common recent ancestor (usually not further back than three or four generations). (BC)

Consciousness. Immediate awareness of things, events, and relations. (IB)

Conservative. A character that resists or does not change over evolutionary time.

Consort pair. In primates a temporary male-female partnership in a polygynous group during the female's estrous.

Conspecific. Considered by taxonomists to be in the same species. (E)

Conspicuous character. Certain anatomical characters are presented during a display which have a particularly obvious aspect.

Consummatory act. The last phase of an appetitive behavior sequence which ends the elicited series of actions and leads under normal conditions to drive reduction. (H) A response that most often terminates a given, frequently occurring sequence of behavior patterns. (V)

Context. The situation in which a signal occurs, which can influence the effect of the signal on a recipient. For example, the song of a male songbird will attract an unmated female in a courtship context but will repel a rival male in a context of territorial defense. The context includes everything besides the signal influencing the effect on a particular occasion. It can include, as in the example given the sex of the recipient and the other signals given in sequence or in concert with the signal in question (See Communication theory, syntax). (IB)

Continental drift. The movement of the continents with respect to one another.

Contingency. Spatial or temporal association. The joining (simultaneous or sequential) occurrence of two behavior patterns, or a stimulus and a behavior pattern, or a behavior pattern and reinforcement, such as can give rise to persistent linkage (see Learning). The contingency of reinforcement plays an important part in operant conditioning; some would say it has an essential, if not defining, role. Also under natural conditions temporal relations between stimulus and response can be of considerable significance, especially in social interactions. Among some birds, the unhatched young learn prenatal to distinguish the calls of their own parents from those of neighbors, apparently because the chicks' parents immediately answer the chicks' calls, and no such contingency occurs for the vocalizations of the neighboring birds. (IB)

Control. A parallel experiment, test or treatment carried out to provide a standard against which an experimental result can be compared.

Control of Behavior. Refers to the underlying mechanisms of behavior.

Control theory. That part of cybernetics dealing with automatic regulation of machines, including organisms. It is highly general in application, hence abstract and mathematical. Its influence in ethology is most prominent in theorizing and research on feedback mechanisms in animal behavior. (IB)

Convergence. A superficial resemblance between two organisms or organs that has evolved under the influence of similar selective pressures, but from widely different ancestries. (mD)

Convergent evolution. Evolution of similar features independently in unrelated taxa, usually from different antecedent features or by different developmental pathways. (F)

Continental shelf. That part of the continental margin between the shoreline and the continental slope. (WS)

Convection cell. In plate tectonics, a pattern of mass movement of mantle material in which the central area is uprising and the outer area downflowing, due to heat variations. (WS)

Coolidge effect. The situation in which a sexually satiated male will again begin to court and copulate if presented with an unfamiliar female with which he has not recently mated. (HJB)

Cooperation. Cooperative behavior. Mutualistic behavior that benefits both parties and which normally involves complex motor acts and reciprocity.

Cooperative breeding. (1) The term cooperative breeding was used as a synonym for communal breeding by a few authors in the early 70s, including myself (Brown, 1970; Fry, 1972; Swainson, 1970), and several recent authors (e.g., Gaston, 1978; Emlen, 1978, and others), particularly in North America. Neither term may be said to have superseded the other. (Brown 1987). (2) It may be used more restrictively to refer to the situation in which two or more breeders cooperate in rearing joint young.

Coordination. Muscular movements must be coordinated in order for behavior to occur. There are two main processes controlling coordination. One is central control where there is a precise series of instructions that are issued by the brain and obeyed by the muscles. Alternatively coordination comes about through peripheral control and is achieved through sense organs in the muscles which send information to the controlling mechanism in the ganglion and thereby influences the instructions issued from the brain. (DM)

Cope's Rule. The common phylogenetic trend toward increasing size within a lineage.

Coprophagia. Refers to eating feces.

Copulation. A part of sexual behavior which is most closely associated with fertilization of the egg by sperm. (DM)

Core. Central zone of the earth, divided into two zones, the liquid outer core (2900-5080 km deep) and the solid inner core (5080 to center). (WS)

Correlation. A statistical relationship that quantifies the degree to which two variables are associated. (F)

Cost. A decrement in something of value to an animal, e.g. energy. Costs are weighed against benefits (see also opportunity cost [HWS])

Cost of meiosis. The cost (in fitness) associated with sexual reproduction where half the reproduction goes into the production of males.

Coupling. Of a gamete or chromosome, bearing at two or more loci alleles that have been designated to be alike in some way (e.g., both wild type rather than mutant). (F)

Covariance. A statistical term for a component of the correlation coefficient. (F)

Crèche. A group of the young of several families tended by one or more adults.

Crèching. Leaving one's young in a social group attended by conspecific adults while out foraging, as in penguins.

Crepuscular. Pertaining to activity at dawn and dusk. [HWS]

Cronism. A type of cannibalism in which the parents eat their young. [BB]

Crossbreeding. Sexual reproduction in which gametes originate from animals belonging to different breeds. [HWS]

Crossing-over. The process of exchange of genetic information between two homologous chromosomes, presumed to occur through breakage of both chromosomes at homologous sites followed by reunion after exchange. (BC)

Cross fostering. An experimental design in which young of one parent are reared by another. (see also infostering) HJB

Crowding. An unusually high spatial density of animals which may cause discomfort or stress. [HWS]

Cryptic. Refers to a color pattern or behavior that allows the animal to remain hidden against the background.

Courtship. Period of pair formation and precopulatory behavior.

Courtship behavior. Behavior patterns and signals that attract the sex partner and lead to mating and conception. (H)

Courtship coloration. The color patterns occurring solely in connection with courtship, the mating season or behavior related to courtship.

Courtship feeding. An epigamic behavior pattern in which the members of a pair feed one another or where one individual (usually the male) feed the others. (mH)

Coy. The behavior of one individual toward the sexual displays of another in which the individual does not cooperate or appears not to be interested although sexually receptive.

Critical period. See Sensitive period. A phase in an animal's life when certain experiences are particularly likely to have a potent developmental effect. [JA]

Cronism. A form of cannibalism. Refers to parents eating their own young. If young are killed but not eaten the appropriate term is infanticide. (IB)

Cross gait. Alternating step in which the front and rear leg of each side move in opposition to each others. progression in anterior limbs occurs when the corresponding rear leg is on the ground.

Crowing. A type of vocalization produced by male chickens which has frequency oscillations of wide amplitude, distinct breaks and a duration of about 2 sec. Thought to have a territorial or mate attracting function. [HWS]

Crust. The outermost shell of earth extends to a depth of 30-50 km below continents and 10-12 km below oceans. (WS)

Cryptic coloration. Concealing, or coloration that makes an animal resemble its background.

Cuckoo behavior. See brood parasitism.

Cuckoldry. Refers to the situation in which a male is helping to rear young that are not related to him. (HJB)

Culture. A body of nongenetic information transmitted from generation to generation or within generations (E); the transfer of information by behavioral means. (B)

Cultural behavior. The passing of information from one generation to the next by non-genetic means. (DM)

Cultural evolution. Changes in traits of organisms due to information transferred through cultural rather than genetic means. (B)

Culture. A body of non-genetic information transmitted from generation to generation or within generations (E); the transfer of information by behavioral means. (B)

Curiosity. Behavior associated with the examination and exploration of new objects, areas or situations.

Cursorial. Adapted for running. [HWS]

Cyclic reflex. An alternative hypothesis to the central pattern generator to explain rhythmic behavior such as walking or swimming. This hypothesis posits feedback control of the behavior whereas the CPG hypothesis open-loop control.

Cytochrome. A group of iron-containing hydrogen or electron carriers in cellular metabolism. (WS)

d. The individual death rate, the average number of deaths per individual per unit time. (WB)

Dabbling. A feeding behavior of anatid ducks, in which the head is thrust below the water and the posterior end of the duck is raised vertically out of the water.

Dance language. A general term for communication among bees with regard to the distance and direction of a food source, nest site or other goal.

Darwin. A unit of measure, the doubling of size in one million years is one Darwin.

Darwinian fitness. (see individual fitness)

Deafferentation. The severing of all afferent nerves, for example, the dorsal roots of the spinal nerves. This is done to determine the endogenous activity of a system.

Dear Enemy phenomenon.

Death feigning. A form of defensive behavior in which the animal becomes immobile as if dead. (DM) Also called thanotosis.

Death shake. Many carnivores especially the canids pick up the prey loosely with the teeth and shake it vigorously and flip it aside. This shaking can result in respiratory collapse in the prey. More intense shaking leads to death by dislocating the neck.

Deception. The concealment or misrepresentation of truth which leads another (individual) into error or to disadvantage. In humans this clearly implies intent but among animals intent is neither known nor necessary. (HJB)

Decision. An animal may perform alternative actions at various points during a sequence of behavior. A decision must have been made at each of these choice points. (does not imply cognition). A commitment of time to a course of action. (HJB)

Decision Rule. The mechanism controlling a decision.

Defecation. Elimination of feces from the body. [HWS]

Defensive behavior. Refers to any behavior which reduces the chances of one animal being harmed by another. (DM)

Defensive threat. A type of threat which occurs while the animal is escaping a predator. (MH)

Deletion. The loss of a segment of chromosome. (E)

Deme. An interbreeding local population of a given species. (mD)

Demic selection (or inter-demic selection). The disproportionate growth of a subset of a population or species. Demic selection has an effect on the general genetic composition of the population if the subsets have different gene frequencies. Demic selection is a type of intergroup selection. (BC)

Demography. The study of populations and how they survive, die, reproduce and grow. (BC)

Dendrite. The short processes of a neuron that carry information to the cell.

Density dependence. Effects correlate with population density. (IB)

Density-dependent selection. Selection in which the fitness of a genotype depends upon the density of the population in which it occurs. As opposed to density independent. (E)

Dependent variable. In an experiment, the effect that is measured when the independent variable is varied.

Depression. In a behavioral sense, a state of severe dejection characterized by reduced activity, seclusion and or stereotyped actions often directed to the body.

Deprivation experiment. See isolation experiment.

Derived. A characteristic that has originated within a taxon (see primitive).

Desensitization. Decrease of a response to a given stimulus with practice or with repeated exposure. The process usually begins by presenting the stimulus at a reduced level so that the animal does not respond (e.g. a recording of thunder at reduced volume) and gradually increasing the intensity on repeated exposures until the animal no longer responds. [HWS] [BB]

Despotic. Refers to the social situations in which one individual controls the activities of others.

Detour experiment. An experiment to evaluate spontaneous insight behavior or the ability of the animal to figure out how to locate an object that it can reach only by a circuitous route. The solution to the detour problem is usually rewarded with food. (MH)

Development. Synonymous with ontogeny. It is concerned with the history of the individual from conception to death and with changes in behavior that are associated with different life stages. (DM)

Developmental homeostasis. The capacity of developmental pathways to produce a normal phenotype in spite of developmental or environmental disturbance. (M)

Dialect. As defined by ethologists refers to the vocalizations (or other signal) of a population of animals that differ from those of another population of the same species. (DM)

Diapause. The period in an insect life cycle when no reproduction takes place.

Differentiation. The development of organs and body parts in ontogeny from simpler antecedent structures. (SG)

Dilution effect. Safety in numbers; the decreased probability of being taken by a predator that stems from being a member of a large group of prey as opposed to a small group. [JA]

Dioecious. Refers to the situation in which the sexes occur in separate individuals.

Dimorphism. Occurrence of two distinct morphological types in a single population. (M)

Diploid. A cell or organism having a double set of chromosomes; the normal chromosome number in the cells (except mature germ cells) in any individual derived from a fertilized egg (see haploid, polyploid). (M)

Direct fitness. The long-term reproductive success of an individual through its direct offspring. Inclusive fitness minus indirect fitness. Direct fitness is synonymous with classical fitness and with individual fitness. Direct fitness has a personal component and a kinship component. The latter is responsible for the evolution of parental care, which, as emphasized by Hamilton (1964), is easily explained by classical individual fitness. (DM)

Direct head scratching. Scratching pattern in birds in which the claw is brought up directly to the head under the wing (see indirect head scratching).

Direct selection. Natural selection (including sexual selection) based on direct fitness. See direct fitness

Directional selection. Selection resulting in a shift in the population mean for the character considered.

Disassortative mating. A pattern of mating in which unlike phenotypes mate more frequently than expected when mated at random.

Discharge. With reference to a drive, the utilization, consumption, annulment, or destruction of a drive (or of an accumulation of action-specific energy or of "impulses") that occur when its consummatory act is given. (V)

Discrimination. (1) Differential response to two or more stimuli. (2) Differential response-strength to two or more stimuli. (3) A hypothetical sensory or neurophysiological event which makes it possible for an animal to form discriminations as defined above. A capacity. (V)

Disgust reaction. Contraction of the pharyngeal musculature, salivation and behavior resembling vomiting. (H)

Disinhibition. (1) An explanation for displacement behavior. This is the notion that many actions are competing for access to the behavioral final common path. When all others are blocked, then a low priority activity like grooming may be distributed. (H) (2) The term applied to the observation, in the course of extinction of a classical conditioned response, that, when an extraneous stimulus (one not previously present in the situation and which does not evoke the same response) is presented together with the conditioned stimulus, the magnitude of CR may be larger than predicted from its magnitude on previous trials. (V)

Dispersion. Refers to the distribution in space of individuals within their natural habitat. (DM)

Displacement activity. (1) Traditionally regarded as an irrelevant activity performed due to excess energy which cannot be released through normal channels. Most frequently this is caused by conflicts between opposing drives. Subsequently displacement behavior was used to describe any irrelevant pattern without any implications as to why it might occur. Today the term is not used due to a number of conceptual difficulties. In psychology displacement refers to what ethologists called redirected behavior. A response that has been identified as a member of one instinct and often occurs in others. On these occasions it is termed a displacement activity. (IC) "A displacement activity is an activity belonging to the executive motor pattern of an instinct other than the instinct(s) activated." (2) A term applied to a response that has been conditioned under one set of deprivations and reinforcement conditions and that then appears under others. (V)

Display behavior. Behavior which has evolved in its role as a communication signal, i.e. an adaptation for its role in communications. (HJB)

Display drinking. Epigamic behavior pattern in many ducks, in which the male dips the bill in the water and raises it as though he were drinking but he does not swallow. (H) Display behavior in many species of Anatid ducks. The individual dips its bill in the water as though it were about to drink, but no water or swallowing occurs. This behavior is more stereotyped than is normal drinking behavior. Ritualized drinking behavior. (HJB)

Display flight. In song birds, especially species of open areas, the birds make conspicuous, stereotyped flights which serve to attract females and to indicate territorial possession to conspecifics. (HJB)

Display or sham preening. Display behavior in many species of Anatid ducks. Drakes raise the wing as if they were about to preen, but the flight feathers are only lightly touched as if to draw attention to the colorful speculum. Throughout, the behavior is more stereotyped than normal preening. (HJB)

Disruptive selection. Selection in which two or more different genotypes are at an advantage and the intermediate types are at a disadvantage. (Same as diversifying selection) F.

Distraction display. Behavior pattern serving to divert a potential predator from the nest; common in ground-nesting birds. (see broken-wing display).

Distress calls. Vocalization which serves to bring the separated young animal once again into contact with its parent or social companions.

Distribution. Systematic arrangement of numerical data according to some ranked measurement scale. [HWS]

Dithering. To act irresolutely, to vacillate; unable to decide among options.

Diuresis. Increased formation of urine.

Diuretic. Any agent that increases formation of urine.

Diurnal. Relating to activity during the day.

Divergence. Adaptations that occur through alterations of the ancestral types. (H)

Divergent evolution. The evolution by natural selection of differences among closely related species that live in different environments. [JA]

Diversity. Of species or other taxa, usually the number present in a particular ecological unit. May also include a measure of the distribution of population sizes among species. (AV)

Division of labor. In social insects there is a division of the different activities of the colony among different castes. This often refers to a reproductive division of labor, where one or a few individuals lay all the eggs or get all the matings whereas most are workers. (mH)

Dizygotic twins. Twins that develop from two zygotes, no more related than other siblings.

DNA. deoxyribonucleic acid. Giant molecules that in most organisms are the nuclear repository for the genetic information and which are replicated and transmitted equally to daughter nuclei. (E)

Dog-sitting position. Resting on the caudal part of the body observed in pigs, cattle and horses and often indicative of disease. [HWS]

Domestication. The process by which man has modified certain species of animal by maintaining them in or near human habitations and by artificial selection. (MDM)

Dominance. This term has specific meanings in three branches of biology. (1) In genetics dominance exists between two alleles when the dominant one commands phenotypic expression in the heterozygous condition; the other allele, termed recessive, is phenotypically expressed only in the homozygous condition. (2) In ecology dominance refers to the relative abundance of a species in comparison with other species in a biological community. (3) In ethology dominance refers to superior position in a rank order or social hierarchy. An individual to which another consistently gives way is said to be dominant in the relationship, the other being subordinate or subdominant. In a linear hierarchy each individual is dominant over those below it, and subordinate to those above it, with the exceptions of the alpha animal, who is subordinate to none, and the omega animal, who is dominant over none. However, social hierarchies may be more complicated, as when animal A dominates B, B dominates C, and C dominates A. Thus dominance is relative to individual relationship. Further complications arise if two or more individuals from an alliance and so collectively are dominant over those that could dominate each of them singly. Such arrangements are common in primate groups, where social organization may also include subdivision into classes according to sex and age status, dominated by a central hierarchy of the older males. Dominance status is anything but static in the course of group life, as lower-ranking animals continually test the ability of those above them to hold their place, and as the struggle of higher-ranking animals to maintain position becomes more difficult with advancing age. Dominance ranking may vary with context, so who gives way to whom may not be the same in contests over spatial claims, food, and sexual access. There are thus problems of definition and assessment of dominance in social relationships as studied by ethologists and sociobiologists.

(IB)(1) Of an allele: the extent to which it produces when heterozygous the same phenotype as when homozygous. (2) Of a species: the extent to which it is numerically predominant in a community. (F)

Dominance behavior. Demonstration of superiority in pursuing or maintaining the dominant position within a social group; priority of access to resources

Dominance hierarchy. A social ranking within a group in which some individuals give way to others, often conceding useful resources to others without a fight. [JA]

Dominance portion of genetic variance. VD. That portion of genetic variance for a given trait that results from the fact that heterozygotes do not always score halfway between homozygotes. (BC)

Dorsal light reaction. Orientation so that light is kept dorsal to and perpendicular to both long and transverse axes of the body.

Dosage compensation. The mechanism by which genes on the x chromosome have the same physiological effect in females (with xx) as in males (with xy). (BC)

Dreaming. During human sleep there are phases during which there are rapid eye movements and elevated breathing and heartbeat rates. Associated with this are characteristic patterns of brain activity which resembles the activity of an awake brain. However, the individual is in a deep sleep and not easily aroused. If the person is aroused from this sleep they usually report that they have been dreaming whereas when awakened from quiet sleep they do not make such reports. Many sleeping animals show similar eye movements and brain activity although we do not know whether they have the cognitive experience of dreaming. (DM)

Drift. (see genetic drift)

Drinking. The process of ingesting water. (DM)

Drive. (1) A drive is a specific internal source of energy which is produced in an automatic rhythmic manner and which leads to a state in which the animal engages in a spontaneous behavior since the drive is pressing for its own release even in the absence of appropriate external stimuli. After the consummatory act is performed, the energy to perform the activity drops and the animal is less likely to perform the action in the immediate future. Over time the drive again rises. (2) A hypothetical state of the animal which is identified by: (a) gross changes in the relative frequency of broad classes of behavior that are not attributable to disease, learning, or growth; (b) changes in running-wheel activity; or (c) changes in cage-motility. Drives may be manipulated by: operations of deprivation (as of food and water), alterations of the hormone or other biochemical balance of the blood (e.g., of ACTH, testosterone, sodium chloride), by temperature changes, or intense stimulation. Some can be specified only by stating the time of the year. (3) A state of the animal established by deprivation of food or water, or by the presentation of electrical shock, characterized by a change in the relative rates of occurrence of a specified set of operant responses. (V)

Drumming. The production of low frequency sounds by various means. (1) Intraspecific communication among woodpeckers in which various pecking patterns are used as signals. (2) A common form of communication in insects in the production of low frequency sounds by stridulating, such as the sounds made by queen honeybees. (3) In many rodents the forepaws are beaten on the ground during threat display. Other species may mark the ground by drumming the hind paws after rubbing them across their scent glands. (4) The sound made by some species of grouse from display perches on logs. (H)

Duetting or duet singing. A behavior associated with pair formation and bonding. Partners coordinate the rhythm and types of call of their respective song parts.

Duplication. The presence of a section of a chromosome more than once in a genome.

Dust-bathing. A behavior pattern that is a component of integumentary care characterized by lying on the side and making a small depression in the substrate, wing-shaking, bill-raking and scratching. [HWS]

Dystocia. Difficult parturition.

E. see extinction rate.

Ecdysis. The act of shedding or molting the outer exoskeleton or cuticle.

Ecogeographical rules. Any of the rules describing regularities in the geographical distribution of phenotypic variations (in pigmentation, body size, etc. such as Gloger's rule, Bergmann's rule, Allen's rule). (mD)

Echolocation. The production of ultrasonic sounds which are reflected off objects in the environment and are used for locating the position of objects. (mH)

Eclosion. Emergence of the adult from the pupa.

Ecological niche. The range of combinations of all relevant environmental variables under which a species or population can persist; often more loosely used to describe the "role" of a species, or the resources it utilizes. (F)

Ecological release. When a competitor is not present in an area such as on an island and individuals of a species expand their feeding and habitat preferences.

Ecosystem. Biotic community and its abiotic environment; the whole earth can be considered one large ecosystem. (K)

Ecotome. A transition zone between two diverse communities. (K)

Ecotype. A local strain (or sometimes subspecies) whose distinctive features develop under the selective forces in a local environment. (D) A genetically determined phenotype of a species that is found as a local variant associated with certain ecological conditions. (F)

Ectotherm. An animal that approximately corresponds in body temperature to the temperature of the environment. (AV)

Edaphic. Pertains to the soil. (K)

Effector. A general term for muscle or gland that are innervated and thus under control of CNS. (IB)

Efference. Nerve impulses running from the central nervous system to the periphery in contrast to afference. The efferent nerves control the function of the skeletal musculature as well as certain inner organs and effectors. (H)

Egg dumping. The act of a female bird in laying eggs in the nests of another bird.

Egg-rolling. Motor pattern frequently observed in ground breeding birds by means of which eggs that have rolled outside the nest are retrieved. The graylag goose retrieves an egg with the bill by gently rolling it while balancing it with the underside of the bill. If the egg is removed during the procedure, the goose completes the instinctive egg-rolling anyway, but without the orientation component. (H)

Eggshell Removal. A behavior in which a parent bird removes eggshells from the nest shortly after the young have hatched. In many species this is a specific action pattern that has been demonstrated to reduce the risk of aerial predation.

Ejaculation. Release of sperm during copulation.

Electrocommunication. The capacity of electric fish to transmit social signals by electric organ discharges. (IB)

Electrophoresis. A technique for separating molecules, particularly proteins, with different charges are separated by their different rates of migration in an electric field. (E)

Emancipation. When a behavior pattern takes on a different or additional function in the course of evolution, where the underlying drive has changed or been replaced by another controlling mechanisms.

Emesis. The act of vomiting.

Emotion. A loose anthropomorphic term referring to an inner feeling, to an aroused state of the body or to the display of certain emotional behavior. (DM)

Encopresis. Defecation associated with extreme excitement or fear. [BB]

Endemic. Of a species: restricted to a specified region or locality. (F)

Endemism, Areas of. Geographic areas often marked by geographic barriers or by noticeable ecological differences from adjacent areas where numerous taxa have differentiated or speciated. These are often refugia.

Endogenous. From within the organism.

Endotherm. An animal that has the ability to regulate body temperature. (AV)

Energy. Used by early ethologists to refer to motivation. It was thought that energy accumulated during deprivation and that this energy governed the intensity and threshold of subsequent behavior. It is now clear that this sort of energy does not exist physically and since energy is a term of capacity it cannot itself be a causal agent. Behavior can be caused in such a way that certain energy changes are a consequence, but energy whether mental or physical cannot drive behavior. (DM)

Engram. A hypothetical neural locus, structure, or persistent activity, presumably anatomically or physiologically identifiable, that plays the same role for the explanation of learned behavior that center does for species-specific behavior. (V)

Entrainment. The synchronization of a biological rhythm with an environmental rhythm. (=Zeitgeber); the effect of environmental changes on the mechanisms controlling circadian or circannual rhythms, leading to the synchronization of the activity pattern of an individual with local conditions. [JA]

Enuresis. Urination that occurs at night during sleep or during excitement or submission or when frightened. [BB]

Environment. Usually, the complex of external physical, chemical, and biotic factors that may affect a population, an organism, or the expression of an organism's genes; more generally, anything external to the object of interest (e.g., a gene, an organism, a population) that may influence its function or activity. Thus other genes within an organism may be part of a gene's environment, or other individuals in a population may be part of an organism's environment. (F)

Enzyme. Organic catalyst that participates in the chemical reactions of a cell. (D)A substance that facilitates specific chemical reactions in the body without being more than transiently changed in the process. The body has a great variety of enzymes, which are of crucial importance for all phases of metabolism, both intracellular and extracellular: such as respiration, digestion, and excretion. They are also vital to the action of genes, a high proportion of which encode recipes for the synthesis of enzymes: hence the slogan "one gene, one enzyme." (IB)

Epibiont. Living attached to the surface of another organism but without benefit or detriment to the host.

Epideictic display. A term for behavioral adaptations that have evolved to estimate population size of a species (Wynne-Edwards' outdated notion).

Epigamic. Physical or behavioral features serving to attract or stimulate individuals of the opposite sex during courtship. (mM)

Epigamic behavior. Behavior associated with mating including courtship displays. (H) (see intersexual selection)

Epigenesis. The developmental processes whereby the genotype is expressed as a phenotype. (F) Biological development viewed as a process in which each stage in the growth and differentiation of an individual, from zygote to mature adult, arises from the preceding stage through the joint action of genetic and environmental determinants. In this view, at any point in development the phenotype already constructed sets the stage, as it were, for further construction, guided by the genes now brought into operation and environmental influences. Thus phenotype, genotype, and environment work in dynamic conjunction and progressive sequence. Epigenesis contrasts with preformationism, according to which the organism is so to speak, prepackaged in miniature or in coded information in the zygote, which has only to be caused to grow for normal development to proceed. Modern views that liken the genetic program to a blueprint and consider the environment as supplying no more than the materials required for development are preformationistic. Classical ethology tended toward preformationism; modern ethology is more inclined toward epigenesis. (IB)

Epigenetic. Developmental; pertaining especially to the interactions among developmental processes above the level of primary gene action. (F)

Epigenetic Effects. Effects on phenotype that are due to gene-environment interactions.

Epiphenomenon. In English this word usually connotes an effect that is causally inconsequential and incidental or secondary to one that is operative or primary. For example, the squeaking sound that emanates from the turning of a pulley does not contribute anything to the work accomplished by the pulley. Mechanistic materialists have argued that mentality is an epiphenomenon and hence that we are deluded when we think, for example, that willing our actions causes them, since the only causes at work are physical ones, which produce mental states but are not affected by them. German ethologists use the word Epiphänomen to refer to an overt concomitant of a physiological state or process. For example, arousal or activation of the autonomic nervous system in situations of danger or threat can cause urination, defecation, trembling, feather ruffling, or hair erection. Such symptomatic expression has particular significance for ethology when it indicates the evolutionary origin of display behavior. The signal function of the behavior may be enhanced through ritualization, and sometimes morphological support evolves. For example, many animals show vigorous tail wagging when aroused. In some species these movements have become threat displays, and in rattlesnakes and porcupines the tail waving also produced an acoustic signal, as a result of modification of structures (vertebrae in snakes, quills in porcupines). Also the excretion of urine for territorial marking is probably derived from an epiphenomenon-urination caused by "anxiety." (IB)

Episome. A circular gene fragment. (S)

Epistasis. A synergistic effect on the phenotype or fitness of two or more gene loci, whereby their joint effect differs from the sum of the loci taken separately. (F)

Epistatic interactions. Reciprocal actions of genes at different loci that can modify the expression of one or the other or both sets of genes.

Epistemology. the study of the origins, methods, nature of and limits to knowledge.

Equilibrium. A condition of stasis, as of population size or genetic composition. When perturbed, the population tends to return to an equilibrium point. (mF)

Ergonomics. The study of work, performance and efficiency or division of labor among animals.

Escape. A form of defensive behavior which may occur as soon as a predator is detected. (DM)

Escape behavior. Rapid locomotion of an animal from any given location that occurs after specific stimuli are presented to it in that place. (see flight behavior). (V)

ESS. (see evolutionarily stable strategy)

Estrogen. A group of female hormones produced by the ovary.

Estrus. A regularly recurring period of ovulation and sexual activity by female mammals. (HJB)

Ethogram. An exact catalogue of all behavioral patterns occurring in a species including vocal patterns. An inventory of all action patterns. (H)

Ethological isolation. Reproductive isolating mechanisms that are due to behavioral preferences; potential mates meet but they do not choose to copulate with one another.

Ethologist. (1) An animal behaviorist who, typically, has been trained in zoology, usually studies the behavior of insects, fishes, and birds more often than that of mammals and other groups. (2) student of comparative behavior. (V)

Ethology. The study of animal behavior from a zoological point of view. Ethology emphasizes species-typical behavior, its adaptiveness, evolution, mechanisms and development. The ethologist applies the same methods to the study of behavior that systematists, morphologists and embryologists use for the study of form. (H) The study of the proximate mechanisms and adaptive value of animal behavior. [JA]

Ethometry. Term referring to the quantitative and functional analysis of releasing mechanisms and key stimuli. (H)

Ethomimicry. Behavioral mimicry. (IB)

Ethoparasite. Various coleopterans have become social parasites of ants in that they live in the ant colony and are fed by the ants. a number of forms have succeeded by offering the appropriate key stimuli, in eliciting feeding behavior from ants. (H)

Ethospecies. Species distinguished primarily by behavioral traits.

Eugenics. A program of decreasing the frequency of deleterious genes in a human population or of increasing that of advantageous genes through artificial selection against the genetically handicapped or in favor of the types considered especially desirable. (BC)

Eukaryote. Cells having a well-defined nucleus and cellular organelles.

Eurytopic. Of a species or population, capable of persistence in a wide variety of conditions or habitats; relative to a stenotopic species or population (q.v.). (F)

Eusocial. Means highly social and refers to the condition in which adult individuals of more than one generation are living together in a group, cooperating in nest construction or brood care and where there is some amount of reproductive dominance. In addition, highly eusocial species have permanent castes, i.e., where some individuals are sterile as adults.

Evolution. (i.e. organic evolution) Any genetic change in a population of organisms from generation to generation; or more strictly, a change in allelic frequencies within populations from generation to generation. (W) In a broad sense, the origin of entities possessing different states of one or more characteristics, and changes in their proportions over time. Organic evolution, or biological evolution, is a change over time of the proportions of individual organisms differing genetically in one or more traits; such changes transpire by the origin and subsequent alteration of the frequencies of alleles or genotypes from generation to generation within populations by the alterations of the proportions of genetically differentiated populations of a species. (F)

Evolutionary conflict of interest. The situation in which those traits that maximize the reproductive success of one individual cause a reduction in the reproductive success of another. Evolutionary conflicts of interest are common between species such as predators and prey or parasites and hosts, but they also occur within a species, such as between competitors for food or females. Evolutionary conflicts of interest may even occur between closely related individuals such as parents and offspring or the members of a pairs.

Evolutionarily stable strategy. A strategy which, if most members of a population adopt it, cannot be invaded by an alternative strategy. When two or more alternative ways of coping with a situation vie with one another, either in a population or in an individual's options, and each alternative is best in some circumstances but not in all, the proportions in which the alternatives occur may reach an equilibrium determined by the combination that yields the highest net return in, for example, reproductive success. In a population in which reciprocal altruism has evolved,

individuals that accept help without ever returning it ("spongers") will initially have an advantage over helpers because they will enjoy the benefits of the altruistic system without incurring any of the costs. Spongers will therefore be selected: they will increase in the population at the expense of the helpers. But as the proportion of helpers decreases, sponging becomes less and less profitable. At some point the advantage the remaining helpers get from one another outweighs the advantage of being exploited, and they make a comeback. This will be checked as their recovery provides an advantage to the spongers. The proportions of helpers and spongers will eventually converge to an equilibrium ratio at which net reproductive success is maximal; that ratio of spongers to helpers becomes the ESS. Any shift away from it results in decreasing success for the increasing variant. This argument, derived from mathematical games theory, has been applied to such matters as the evolution of threat display and parental investment. It was originally deployed in evolutionary biology and ethology by Maynard Smith (1974). (IB)

Evolutionary clocks. Point mutations occur and are fixed in the genome at a reasonably regular rate. An evolutionary clock uses these substitutions as a measure of the amount of time that has passed between the divergence of two lineages from each other.

Exafference. Afference resulting from stimulation of exteroceptors through environmental change with respect to which the animal is passive; for example, a cloud passing in front of the sun will cause the animal to perceive a drop in light intensity not brought about by its own activity. Compare Reafference. (B)

Exaptation. Same as preadaptation except it does not imply foresight. (SG)

Excitability. Excitability is a basic property of living organisms in which changes in state elicits an arousal response. Refers to an endogenous production of excitation of the CNS occurring even in deafferented animals. (H)

Excitation. A hypothetical state of the animal used in various ways to account for the occurrence of a response and presumed to be great when response magnitude is large.

Exclusion principle. The principle stating that two species cannot coexist at the same locality if they have identical ecological requirements. (M)

Exhaustion. Of action-specific energy, or of specific action potential, a hypothetical process postulated to account for the data of adaptation or habituation of a species-specific response.

Extra-pair copulation. Refers to copulations that occur between individuals that do not have a pair bond (in species in which pair bonding is the norm). Now often abbreviated EPC

Exogenous. From outside the organism.

Exon. A part of an interrupted gene that is translated into a polypeptide. (F)

Experience. Experience arises through storage of learned contingencies. (H)

Exploded lek. Sites where individual males display and court females, usually associated with a specific environmental feature such as a drumming log or display perch.

Exploratory behavior. Behavior which produces the species-typical orientation in time and space necessary for effective learning. (H)

Explosive breeding assemblage. The formation of large groups of reproducing individuals in species that breed on only a few days each year. [JA]

Exponential growth. A phase of growth of a population in which the time of doubling in size is constant. Under exponential growth the log of the number of individuals increases linearly with time. (BC)

Extended family. A family containing kin beyond the nuclear family.

External fertilization. A form of sperm transfer in which eggs and sperm are united outside the body.

Exteroreceptors. Sense organs which perceive stimuli emanating from outside the body: eyes, ears, sense of touch, warmth and cold receptors, current and electrical receptors; in contrast to receptors that respond to internal information such as proprioceptors. (H)

Extinction. Termination of a lineage (SS). The process by which learned behavior patterns cease to be performed when they are no longer appropriate. (DM)

Extinction rate. E, the number of species lost per million years. (SS)

Extinguish. (1) To omit reinforcement of a response sufficiently often that a decrement in response-strength is observed. (2) With reference to a response, to decrease in magnitude with the omission of reinforcement. (V)

Extravagant character. These are characters that have evolved by female choice and the runaway process. they are usually characters which have an obvious natural selective disadvantage but are maintained due to sexual selection.

Eye contact. A behavioral element in the social interactions of some animals.

Eye spots. In many Lepidopterans and some Homopterans eye spots are present on the rear wings. These spots are normally covered when the animal is resting, but are displayed when the animal is disturbed as it quickly raises its forewings. The eye spots strongly resemble mammalian eyes.

Eye-brow flash. In human greeting gestures, the raising of the eye-brows followed often by a smile.

Eye-camouflage. The eyes of many species of fishes and other animals are obscured by a black eye bar.

F1 generation. First filial generation. The progeny resulting from a parental cross between two pure lines. (BC)

F2 generation. Second filial generation, resulting from the mating of two F1 individuals. (BC)

Facies. The representation of a biome in the sediments, e.g., marine facies are sediments of marine origin.

Facing away. Appeasement where head is averted from opponent.

Factor analysis. A statistical method for analyzing the degrees of covariation among a number of different measures of a capacity such as intelligence or of a type of behavior such as courtship. Factor analysis involves working out the partial correlation coefficients between the different combinations of variables and treating them in such a way as to reveal dependence on a small number of common factors. Ethologists have used this and similar techniques (hierarchical cluster analysis, multivariate analysis, principal component analysis) to generate evidence for the existence and organization of drives or motivational systems underlying behavioral patterning. (IB)

Fall song. See Subsong.

Family. This term is used in two different areas of biology. (1) In taxonomy is a level of classification that groups together closely related genera. (Families in turn are grouped into orders at the next higher level of taxonomy.) For example, the catlike carnivores belong to the family Felidae, the doglike carnivores constitute the Canidae, and the weasel-like carnivores, the Mustelidae. (2) In ethology a family is a social unit consisting of a kin group: one or both parents living with their offspring. The main function of the family in this sense is provision of parental care. Families occur in all mammalian species, in almost all birds, in some other vertebrates, especially fish, and among some invertebrates, for example, insects, spiders, and myriapods. Families may be two-parent, maternal or paternal. Two-parent families in which both parents are equally or similarly concerned with the young are found in the majority of birds, some fishes (many cichlids), and some mammals gibbons, canids). In other cases the parents' contributions to care of the young differ (see Division of Labor). In many birds the male takes no part in incubation but contributes more or less equally with the female in providing food for the nestlings. The extreme of this division of labor is one parent taking sole charge. The maternal family is typical of mammals, where the mother's parental role is obligatory because she alone produces the milk. It occurs also in many gallinaceous birds and hummingbirds, fishes, spiders, and scorpions. Paternal families are found commonly in fishes, as in sticklebacks and labyrinth fish, and among birds, in phalaropes, painted snipe, and rheas. The societies of insects also take the form of families: maternal in the Hymenoptera (ants, bees, and wasps) and the two-parent in the termites, in which the males remain with the queen after the nuptial flight and contribute to the upkeep of the colony. As a rule the animal family breaks up after the young become independent and is consequently only a temporary social unit. However, in many species with two-parent families the two adults may remain together as a pair. In some species, the young stay with both parents or with the mother beyond the time of independent foraging, so the family may include young of different ages (see helpers-at-the-nest). [IB]

Fatigue. A pejorative synonym for habituation, used preferentially when a lot of work (physical) is involved in the response considered. (V)

Fecundity. Reproductive potential as measured by the quantity of gametes, particularly eggs, produced. (M)

Fear. (1) The behavior produced either by sudden and intense stimulation or by specific classes of stimuli that must be identified empirically for each species studied. Responses include alterations of sphincter control, flight behavior, respiratory changes, and the suppression of behavior occurring at the onset of stimulation. (2) A drive or emotion postulated as underlying fear. (3) Anxiety. (V)

Fear of falling. (See visual cliffs)

Feedback. Information processing in which the result of the action of a certain system component serves as an initiator of new action in the system. Feedback involves circular transfer or cycling of information. Negative feedback tends to slow the action down or turn it off whereas positive

feedback tends to accelerate the action. Feedback occurs when the consequences of the behavior affect future behavior. (DM)

Feedback system. A self regulating system in which the actual value of a parameter is continuously compared with and corrected towards a predetermined reference value or set point.

Feed-forward. Change that anticipates needs.

Feeding. Includes all those activities that are involved in obtaining, handling and ingesting food. (DM)

Feeding aggregation. A loose association of various animal species during feeding. The association is due to their common attraction to a food source rather than to one another. (H)

Feeding chase. In some species such as penguins, the parents return to the offspring for feeding and before they give up their food they run about, hotly pursued by their offspring and sometimes strange youngsters. (HJB)

Feeding tradition. In certain mammals and bird groups, the young learn food preferences from the mother or the parents and in this manner certain regional diet peculiarities may develop.

Female choice. Non-random mating by females. (HJB)

Female defense polygyny. See polygyny.

Fertility. Reproductive potential as measured by the quantity or percentage of developing eggs or of fertile matings. (M)

Fighting. A physical conflict between two individuals. (DM)

Filial cannibalism. Cannibalism of kin particularly siblings.

Filial imprinting. See Following response.

Final common path. Competition for effect or output when the animal is faced with motivational conflict.

Fine-grained environment. The environment experienced by an organism with good homeostatic mechanisms, high behavioral plasticity and mobility; experienced as a succession of interconnected conditions [LBC]

Fission. (1) One chromosome breaks into two. (2) Social groups that divide.

Fitness. (1) The average contribution of one allele or genotype to the next generation or to succeeding generations, compared with that of other alleles or genotypes. (F) (2) In population genetics, W , the rate of increase of one genotype (Aa , aa) relative to another (AA); $S=1-W$ where S is the selection coefficient. (See inclusive fitness, individual fitness, population fitness; direct fitness, indirect fitness)

Fitness benefit. That aspect of a trait that tends to raise the inclusive fitness of individuals. [JA]

Fitness cost. That aspect of a trait that tends to decrease inclusive fitness of individuals. [JA]

Fixation. Attainment of a frequency of 1 (i.e. 100%) by an allele in a population, which thereby becomes monomorphic for the allele. (F)

Fixed action pattern. Translated from German meaning "inherited movement coordination". In the behavior of an animal one repeatedly observes certain movements which have a constant form and which need not be learned and those movements are characteristic of the species. FAP refers to a kind of genetically fixed inborn ability. (H)

Fledging. When a young bird leaves its parents' nest.

Flehmen. A widely distributed behavior pattern among mammals in which the mouth is opened, the teeth exposed by retracting the upper lip (lip curl), the nasal openings closed and the head jerked back. It occurs particularly in the reproductive season after the male has licked the females urine or vulva. (H) This behavior is associated with the operation of the vomero-nasal organ.

Flexibility. The ability to change over the life of an individual.

Flight behavior. (1) Flying of birds and bats. (2) Rapid locomotion of an animal from proximity to another animal that is exhibiting threat or attack behavior. (V)

Flight distance. The distance at which an animal will flee from a predator or rival. Flight distance varies from species to species and individual to individual. (H)

Floater. A nonbreeder that is a potential breeder and is not bound to a particular territory.

Flock. A number of animals traveling in company, commonly of the same or similar species.

Flocking. A group of birds that remains together as a result of social attraction between individuals. (DM)

Flow diagram. A block and arrow diagram showing the sequencing of transitions from one pattern to the next. (HJB)

Fluffing. (See ruffling)

Focal animal sampling. A method for taking observational data in which one individual is observed for long periods of time before proceeding to the next animal.

Following response. The innate disposition of young nidifugous birds to approach and follow a moving object shortly after hatching. This moving companion may be but does not have to be acquired during a short sensitive period in early life. The early experience may affect later preferences. For example, a jackdaw hand-raised by Lorenz considered humans as parent or sexual companions throughout its life.

Food-begging. Begging by the young for food from the parents. In courtship a ritualized form of begging may occur between partners. (see courtship feeding). (H)

Food-running. Distinctive rapid locomotion most frequently displayed by young birds in the presence of peers after grasping worms or worm-shaped objects with their beaks. A bird running with such an object in its beak is followed by peers who attempt to steal the object. [HWS]

Foraging. Refers to behavior associated with searching for subduing, capturing and consuming food. (DM)

Foraging strategy. The methods used by an animal in its search for food.

Forced copulation. Rape, in which a male inseminates a female against her will and with the consequence that her fitness is reduced on average. [JA]

Foreleg Kick. Several species of male ruminants will use a stiff-legged, forward-directed kick with their forelimb as a part of the courtship behavior. The forelimb may be raised between the female's hind limbs or to the side of them. [BB]

Fossil. Any evidence of the former existence of a living thing, including bones, casts, molds, etc. (mD)

Foster rearing. Fostering The raising of young by individuals other than the natural or biological parents. If this is done by individuals of a different species, it may be referred to as interspecific fostering, or cross-fostering, or cross-species rearing. When young animals are raised by people it is called hand-raising. As a rule only human contrived situations are referred to as foster rearing; hence brood parasitism is usually excluded, and if parental substitution occurs in other natural conditions, the more common term is "adoption." (IB)

Founder effect. The principle that the founders carry a fraction of the total genetic variation of the source population; when a new population is established in isolation, its gene pool is not identical to that of the parent population because of sampling error. (E) Changes in gene frequencies in a population through genetic drift which is caused by a few animals founding a new population.

Frameshift mutation. A mutation resulting from the insertion or deletion in DNA of one or more bases, thus changing the boundaries of the codons and altering the whole string of amino acids subsequent to the insertion or deletion. (BC)

Fraser Darling effect. Acceleration and synchronization of reproductive state in a breeding colony as a consequence of communal social stimulation. The effect is greater as group size or density increases. Darling (1983) first proposed this effect after studying the timing of breeding in different-sized colonies of herring gulls. An alternative explanation of localized breeding synchrony in colonial animals is that individuals in the same reproductive state attract one another to the same area. This is sometimes called the Orians effect after Orians (1962), who first suggested it (See Communal Courtship). (IB) Acceleration and synchronization of reproductive state in a breeding colony as a consequence of communal social stimulation. (IB)

Fatricide. The killing of siblings. (see Siblicide)

Freemartin. The female twin of a bull calf. Freemartins are usually infertile. [HWS]

Free-running cycle. The cycle of activity of an individual that is expressed in a constant environment [JA], i.e. without environmental cues.

Freezing behavior. Adoption of a fixed, immobile stance usually in an anti-predator context.

Frequency-dependent selection. Selection in which the fitness of a phenotype is a function of its frequency in the population.

Frequency distribution. A synthetic presentation of a series of observations, obtained by specifying the number of observations falling in each class. (BC)

Frequency modulation. Variation of the wavelength of energy transmitted in wave form. In bioacoustics and animal behavior literature the term usually refers to sound, the frequency modulation of which is experienced as change of pitch. Melody is thus an effect of frequency modulation. (IB)

Fright. The feeling of being threatened with its accompanying alertness and acumen. Fright unlike fear is object-oriented, i.e. it occurs only in response to tangible danger.

Fright response. The escape response of animals when in physical danger. (H)

Frugivorous. Feeding primarily on fruits.

Frustration. Behavior, often appearing to be inappropriate, resulting from a failure of an expected event to occur which itself would satisfy some primary or secondary need. (H) The operation of preventing an animal from making some response. This may be done in any of three ways: (a) by withholding the stimulus for the response, when the stimulus ordinarily appears as the consequence of a previous response; or (b) by mechanically preventing the response from occurring. (V) A state of motivation that arises in situations in which the consequences of behavior are less than those which the animal has been led to expect on the basis of past experience. (DM)

Fugitive species. One that occupies temporary environments or habitats and so does not persist for many generations at any one site. (F)

Fundamental Theorem of Natural Selection. Formulated by R.A. Fisher and states that the rate of evolution at the level of the individual increases with genotypic variance. (SS)

Function. As used in everyday language function refers to the job that something is designed to do. Biologists use function in the more specialized sense of the adaptive significance of the character or how that character increases reproductive success of the individual. (DM)

Fusion. (1) Two chromosomes fuse into one. (2) Two social groups join.

Gaia Hypothesis. The theory that the earth functions as a single independent living organism. [LBC]

Gallop. The fastest naturally developed gait. The leg movement is similar to the canter except the diagonal beat is extended so the forehoof hits the ground slightly later than the hindhoof and the phase of total suspension in the air is longer. [HWS]

Gamboling. Bouncing and turning, seemingly stiff-legged; seen in young sheep and goats when playing. [HWS]

Game theory. A part of applied mathematics dealing with the situation in which the probabilities of "winning" and "losing" vary with the strategies chosen by the players. See ESS. (IB)

Gamete. A mature male or female reproductive cell (sperm or egg) (G)

Gametic selection. Differential survival of sperm or egg cells. (BC)

Gametogenesis. The combined process of cell division and differentiation which results in the production of gametes.

Ganglion. A dense cluster of many neurons in the central nervous system. [JA]

Gape. Flehmen response in male cats.

Gaping. Young song birds react to tactile stimuli by stretching their neck and opening the beak vertically upward.

Gause's Hypothesis. The theory that two species with the same ecological requirements cannot coexist in the same place indefinitely; that is they cannot form steady state populations if they occupy the same niche. [LBC]

Gemmule. Darwin's term for a hypothetical particle of heredity carried by all cells and capable of moving to sex cells, thus permitting a direct influence of environment upon heredity. (SG)

Gene. The functional unit of heredity; a cistron. (F)

Gene conversion. When a gene is altered from within the genome. This is thought to occur through a breaking of both strands of DNA and the damaged or missing sequence on one chromosome is copied from the homologous strand and inserted into the damaged chromosomes.

Gene family. Two or more loci with similar nucleotide sequences, that have been derived from a common ancestral sequence. (F)

Gene flow. The movement of genes within a population or from one population to another, resulting from the dispersal of gametes (such as pollen by wind) or of zygotes (as by migration of fertile females, for example). (D)

'Gene for'. This is a short hand terminology used by behavioral ecologists to mean that there are differences among individuals and that those differences are in part due to genotypic differences.

Gene frequency. (p and q) The proportion of gene copies in a population that an allele accounts for; i.e., the probability of finding this allele when a gene is taken randomly from the population (same as allelic frequency). (F)

Gene pool. The totality of the genes of a given sexual population existing at a particular time. (D)

Generalist. Feeds on a wide range of food types; a jack-of-all-trades.

Generalization. See stimulus generalization or response generalization.

Generalized. Applying to an organism or character judged to be unchanged from a presumed common ancestral state.

Generation time. 1. The average duration of a life cycle between birth and reproduction. 2. The mean period of time between reproduction of the parent generation and reproduction of the first filial generation. [LBC]

Generational mutualism. A mutualistic relationship between members of different generations, as between parents and offspring.

Genetic code. The code that relates nucleotide sequences in nucleic acids to amino-acid sequences. Each triplet of nucleotides designates a particular amino acid; thus, the genetic code allows the translation of information stored in DNA and the use of that information in protein synthesis. (BC)

Genetic colonization. A novel sort of parasitism practiced by *Agrobacteria* with plants; introduction of genetic information into a host, which induces the host to synthesize products that only the inducer can use. (S)

Genetic death. A death due to genotype, hence contributing to natural selection. Deaths that are random with respect to genotype are not genetic deaths. (F)

Genetic distance. Any of several measures of the degree of genetic difference between populations, based on differences in allele frequencies. (F)

Genetic drift. Changes in the gene frequency of a population due to chance (sampling error), rather than migration, mutation or natural selection; especially evident in very small populations. (mD)

Genetic equilibrium. A state reached by a population when gene and genotype frequencies do not change in successive generations. (BC)

Genetic evolution. (see evolution) changes in gene frequency over generations.

Genetic load. The difference between the average fitness of a population and its maximal possible fitness, that of the fittest genotype (whose fitness is equal to 1); the sum total of genetic deaths per generation (as a proportion of the population). (D)

Genetic marker. A gene mutation that has phenotypic effects useful for tracing the chromosome on which it is located. (BC)

Genetic mosaic. An individual whose tissues are a mix of different genotypes. [JA]

Genetic polymorphism. The co-occurrence of two or more alleles at the same locus in a population at frequencies that cannot be accounted for by recurrent mutation [LBC]

Genetic revolution. Dramatic changes in the genome accompanying speciation. (SS)

Genetic variability. Two measures: (1) mean polymorphism, P , the proportion of loci that are polymorphic and (2) heterozygosity H , the proportion of loci that are heterozygous.

Genetic variance. That portion of the phenotypic variance caused by variation in the genotype of the individuals in a population. (E)

Genetical conflict of interest. (see evolutionary conflict of interest)

Genic selection. The differential propagation of different alleles within a population; i.e., a form of natural selection in which the frequency of an allele is determined by its rate of propagation relative to that of other alleles at that locus, averaged over the variety of genotypes in which it occurs (cf. individual selection, kin selection, natural selection). (F)

Genome. The assembly of genes of any one individual organism. (B)

Genotype. The set of genes possessed by an individual organism which specify its phenotype; often, its genetic composition at a specific locus or set of loci singled out for discussion. (F)

Genotype-environment correlation. The nonrandom assortment of particular genotypes among particular environments within a given population. (BC)

Genotype-environment interaction. The interplay of a specific genotype and a specific environment affecting the phenotype. The variance due to this interaction V_I , is part of the total phenotypic variance of a trait. (BC)

Genotypic frequency. The relative proportion of a particular genotype in a population.

Geographical barrier. Any terrain that prevents gene flow between population. (M)

Geographical divergence. The evolution of a common ancestral form into two or more different forms in different geographical areas (= geographical replacement). (H)

Geographical isolate. A population or group of populations prevented by an extrinsic barrier from free gene exchange with other populations of the same species. (M)

Geographical isolation. The prevention of gene flow between populations by geographical barriers. (D)

Geographical speciation. The acquisition of characters that promote or guarantee reproductive isolation of a population after the external barriers break down after geographical isolation from other populations of the parental species. (M)

Geographical variation. The differences between spatially segregated populations of a species; population differences in the space dimension. (M)

Geometric mean. The n th root of the product of n values. $G = (x_1 \cdot x_2 \dots x_n)^{1/n}$.

Geophagia. Refers to eating soil or earthy substances. [HWS]

Geotaxis. An orientation response with respect to gravity. (V)

Gestalt. When it is shown that a particular response or set of responses is under the control of a complex set of stimuli that has not yet been experimentally defined, then the complex set of stimuli is often termed a Gestalt. (V) A pattern of biological phenomena in which the properties of the functional whole differ from those predicted from the sum of the component parts. [LBC]

Gestalt psychology. A branch of psychology that attributes behavioral responses to the recognition of the sum of all elements of a configuration (in contrast to simple cues). (H)

Giant fiber or giant neuron. Unusually large cells that are found in the nervous systems of many invertebrates and some vertebrates that are used to trigger escape or startle responses.

Gloger's rule. The intensity of pigmentation in warm-blooded species tends to decrease with mean temperature. (H)

Gobbling. Vocalization of mature male turkeys produced usually as a series of 3-7 sounds accompanied in most cases by head movement. [HWS]

Gondwanaland. In the late Carboniferous the land masses were divided into two supercontinents, Laurasia to the north and Gondwana to the south.

"Good genes" hypothesis. The argument that mate choice advances direct fitness because it enhances the survival chances of offspring of choosy individuals by providing them with genes that promote viability. [JA] Refers to an argument explaining female choice in sexual selection where female's mate with males who have genotypes that will be more likely to produce successful offspring.

Grade. A level of phenotypic organization attained by one or more species during evolution.

Graded potential. Changes in electric potential on the membrane of living cells which do not lead to action potentials.

Graded response. A response that varies in preparation to the strength of the stimulus evoking it. (IB)

Gradual evolution. Evolutionary change occurs slowly and at a more or less constant rate (see punctuated evolution).

Gravid. Female carrying eggs or young.

Grass-pulling. When two herring gulls happen to meet at their territorial boundary, a confrontation often occurs. The opponents viciously pull up tufts of grass. The behavior has been explained as a conflict between two mutually inconsistent drives, flight and fight. This results in a displacement activity, in this case the grass pulling was thought to resemble nest building. However on closer analysis the behavior is more like the movements used during fighting and so should be considered a redirected behavior. (H)

Grazing. Feeding on herbage, algae or phytoplankton by consuming the whole food plant or by cropping the entire surface growth. [LBC]

Gregariousness. The tendency of animals to form social groups. (DM)

Grooming. Behavior associated with care for the body surface. (r)

Ground-scratching. A sequence of rapid foot movements performed that manipulate the ground surface in poultry. [HWS]

Group-living. A species may be termed group-living if at any time in the year it normally lives in groups. Group-living, therefore, encompasses not only the communally breeding species but also species that breed colonially without helpers, those that breed in isolated pairs but form groups when not breeding, and any species that for whatever reason forms social groups on occasion (Alexander, 1974)

Group selection. The process of selection in which a group of individuals of one deme rather than a single individual is the target of selection; a process by which characters can be selected which benefit the group but not the individual (interdemic selection). (mM) The differential rate of origination or extinction of whole populations (or species, if the term is used broadly) on the basis of differences among them in one or more characteristics. See Interdemic selection, species selection. (F)

Group territory. A territory held by a group of three or more individuals. Group territories are normally but not invariably held all or most of the year. In most cases they are all-purpose territories, although some colonial bee-eaters are exceptions (Hegner et al., 1982)

Gular fluttering. A thermoregulatory behavior of some birds analogous to panting in which air is moved rapidly over the wet surfaces on the inside of the mouth. Refers specifically to the associated behavior where the skin on the throat flutters rapidly.

h2. (See heritability)

Habitat saturation. The condition that occurs when that point is reached on the continuum of competitor pressure where all suitable territories are occupied and defended. Competitor pressure refers to the number of individuals seeking territories. If territories are essentially incompressible, saturation is a clearly defined point.

Habitat selection. The capacity of an organism (usually an animal) to choose a habitat in which to perform activities. (F)

Habituation. (1) The decrement in response-strength which occurs with the repeated elicitation of a response. Response decrement is a function of the number of elicitations, it is specific to the response (and independent of the stimuli eliciting it), and from which recovery is slow or absent until the stimulus is increased. (V) (See also Stimulus habituation)

Haldane's rule. The heterogametic sex in species hybrids is often wholly or partially sterile owing to imbalance between the single sex-chromosome derived from one parent species. (H)

Half-sibs. Individual organisms with one parent in common.

Hamilton's Rule. If $rB-C > 0$ then the behavior in question will be performed where B refers to the gain (in fitness) for performing the act, C is the opportunity cost or what the individual would have gained had they performed a different act and r is relatedness. Also $B/C > 1/r$

Handedness. the preference for using the right or left hand for particular activities. [BB]

Handicap Principle. Characters are preferred by females precisely because they are a handicap in terms of male fitness and thus serve as an advertisement of male quality. The character demonstrates the male's ability to survive in spite of his handicap which means he must be extra good in other respects.

Haploid. A cell or organism possessing only one of each homologous pair of chromosomes hence a single gene copy at each locus. (see diploid).

Haplodiploidy. A genetic system found in all Hymenoptera (Ants, bees and wasps) and some other animals in which males develop from unfertilized eggs and are haploid whereas females are diploid (also called arrhenotoky). (E) Haplodiploidy creates unusual asymmetries of relatedness: full sisters are related by 3/4 whereas sisters are related by 1/2 to brothers and females by 1/2 to their own offspring.

Hardwired behavior. Not a technical term but refers to behavior whose organization and control occurs by virtue of known physical connections in the nervous system.

Hardy-Weinberg Equilibrium. A rule for predicting genotype frequencies on the basis of gene frequencies under the assumption of random mating and no selection. (BC). In large randomly

interbreeding populations, genotypic frequencies will reach an equilibrium at the value $(p + q)^2 = p^2 + 2pq + q^2$ where p and q are the frequencies of the two alternative alleles in question. (mD)

Harem. A mating system in which there is no male who has exclusive access to a number of females for mating. (HJB)

Hatching. The cracking of the egg shell and emergence of the young organism from the egg. (DM)

Hawking. Feeding in flight, particularly leaving a perch, catching a prey and returning to the perch.

Head flagging. An appeasement gesture during the mating and pair formation ceremony in the black-headed gull which consists of turning away the black facial mask from the opponent or mate. (H)

Head scratching. (See indirect or Direct head scratching)

Helper. The situation where adult individuals are assisting with the rearing of young that are not their own although they are usually close relatives. (HJB)

Helping behavior. An individual that performs parent-like behavior toward young that are not genetically its own offspring, typically in company with the young's real parents (thus excluding brood parasitism and brood capture). Helpers may be breeders or nonbreeders. They may or may not benefit the young or their parents. Helpers may be altruistic, cooperative, or selfish. Note that breeding status and conferral of benefit or harm to recipient or helper are irrelevant to the definition but helpers are often collateral kin.

Hemimetabolous. Undergoing development (insects) which is gradual lacking sharp divisions.

Herd. (1) an epigamic behavior pattern in territorial male cervids and bovids connected with defending the harem during the rut. A male red deer pursues a female which leaves the herd, overtaking her on the side, he moves in a broad arc on the side of the female away from the herd threatening and intimidating her. (H) (2) Also a form of social behavior in mammals where individuals remain together due to their social attraction. (DM)

Heritability, h^2 (broad sense). The genetic variance divided by the phenotypic variance; an estimator of the degree of resemblance between offspring and parent which is due to genetic variance. (E) The proportion of the variance (q.v.) among individuals in a trait, that is attributable to differences in genotype. (F) See coefficient of genetic determination. (BC)

Heritability, narrow sense. The ratio of the additive genetic variance to the total variance. An estimate of the efficiency of selection. (BC)

$$V_G = V_A + V_D + V_I \text{ then } h^2 = \frac{V_A}{V_G}$$

V_G =Total genetic variance

V_A =Variance due to additive genetic effects

V_D =Variance due to dominance effects

V_I =Variance due to gene-gene interaction effects.

Hermaphroditic. Possessing the phenotype of both sexes in organisms with male-female sex differentiation. (E)

Heterochrony. An evolutionary change in phenotype based on an alteration of timing of development; phyletic change in the onset or timing of development so that the appearance or rate of development of a feature in a descendant ontogeny is either accelerated or retarded relative to the appearance or rate of development of the same feature in an ancestor's ontogeny. (SG)

Heterogametic sex. The sex (males in mammals, but females in birds) having two dissimilar sex chromosomes or only one sex chromosome. (AV)

Heterogamy. Matings between unlike individuals; sometimes the preferential matings of individuals of dissimilar genotypes or phenotypes. (D)

Heterogeneous summation. A rule describing the additive effect of key stimuli in releasing a species-specific instinctive movement.

Heterokaryotype. A genome or individual that is heterozygous for a chromosomal rearrangement such as an inversion. A homokaryote is homozygous in this respect.

Heterozygote. An individual containing two different alleles of a given gene at a certain locus, such as Aa. (F) (see homozygote)

Heterozygous advantage. The manifestation of higher fitness by heterozygotes at a specific locus than by homozygotes. (F)

Heterosis. Equivalent to hybrid vigor: the superiority in one or more characteristics (e.g., size, yield) of crossbred organisms compared with correspondingly inbred organisms, as a result of differences in the genetic constitutions of the uniting parental gametes. Sometimes used to describe the higher fitness of heterozygous than homozygous genotypes, which is better termed euheterosis, and which is distinguished from luxuriance, a superiority in size, etc., that does not increase fitness. (F)

Heterotroph. An organism that does not synthesize the compounds it uses for energy. (F)

Heterozygote. An individual containing two different alleles of a given gene at a certain locus, such as Aa. (F)

Heterozygous advantage. The manifestation of higher fitness by heterozygotes at a specific locus than by homozygotes. (F)

Heuristic. Providing direction in the solution of a problem but otherwise unjustified; a rule of thumb. [LBC]

Hibernaculum. The domicile of an animal in which it hibernates or overwinters.

Hibernation. A form of winter dormancy characterized by a slowing of metabolic processes and a marked fall in body temperature. (DM)

Hierarchy. The occurrence of things in a certain rank or order, such as the hierarchical organization of behavior, hierarchical organization of neural centers or hierarchical organization of a social group. Hierarchy refers to situations in which there is one entity-a "boss" - that controls all entities directly below it. (mH) (V) In a hierarchy, information may flow from lower to higher

levels, but control is directed from higher to lower levels only. That is, in a hierarchy the elements are ordered in such a way that higher-ranking elements control lower ones. (DM) A linear social hierarchy is formed as a straight line of dominance-subordinate relationships through the whole group. The highest ranking animal dominates all, the second highest all but the first, the third highest all but the first two, etc. [HWS]

Histone. One of a class of proteins that are constituents of the chromosomes in eukaryotes. (F)

Hitchhiking. The use of animals of other species as means of transport. (IB) Hitchhiking genes are silent genes that get into the gene pool by their association with other genes.

Hoarding. Many birds and mammals gather food for the winter and hide it at certain places. (H) (see larger hoarding and scatter hoarding).

Holism. The belief that the sum of the parts is greater than the individual components, that we cannot understand phenomena through reductionism.

Holometabolous. Complete metamorphosis in insects, egg-larva, pupae (contrast hemimetabolous).

Home range. The entire area which is normally occupied by an individual animal or stable group throughout the life of the animal. This area is distinct from a territory or individual distance. (H)

Homeostasis. Maintenance of an equilibrium state by some self-regulating capacity. (F) Refers to the maintenance of an equilibrium between the organism and the environment. Usually used to denote the equilibrium of the internal conditions of the individual such as body temperature, blood sugar level, water balance, etc.

Homeotic mutation. A mutational change of one structure into another of the organism's structures. (F)

Home range. An area that an animal occupies but does not defend, in contrast to a territory, which is defended. [JA]

Homing. The ability to return to a nest or home range after displacement. (DM)

Homogametic sex. The sex having two similar sex chromosomes (see heterogametic sex). (AV)

Homogamy. Matings between individuals of like phenotype, genotype or structure. (D)

Homologous chromosome. The members of a chromosome complement which bear the same gene loci. (F)

Homologs. Chromosomes that carry genes governing the same characteristics and that pair during meiosis. (BC)

Homology. Similarity in a character between two or more species that is due to common descent. The structures are said to be homologous. (W) The similarity of organs, structures and behavior patterns due to their common evolutionary ancestry.

Homoplasy. Possession by two or more species of a similar or identical trait that has not been derived by both species from their common ancestor; embraces convergence, parallel evolution, and evolutionary reversal. (F)

Homosexuality. Sexual behavior between individuals of the same gender. (IB)

Homozygote. An individual containing the same two alleles of a given gene at a certain locus, such as aa. (see heterozygote).

Homozygous. An (diploid) individual possessing two alleles at a given locus, such as AA or aa. (mD)

Honest advertisement. A form of advertisement in which the individual communicates its true characters such as size and ability to defend a territory rather than exaggerating or hiding its abilities. (DM)

Honest signaling. Providing signals to others that accurately convey information about the signaler's fighting ability or quality as a potential mate.

Honey or nectar guides. Distinctive flower markings often visible only in the UV that are adapted to attract insects that engage in pollen transfer. They are lines running from the outside of the petal to the center where nectar may be found.

Hopeful monsters. The notion perpetuated by Goldschmidt of a single aberrant animal serving as the progenitor of a new higher taxon. (SS)

Hormone. Organic substance produced by internal secretory (ductless) glands transported through the blood stream. (IB)

Horning. Digging or churning the ground using the horns or forehead by male cattle and assumed to be an aggressive signal. [HWS]

Host imprinting. This term is frequently used to refer to the relatively strong fixation of brood parasites on their host species. Thus it is known of the European cuckoo that each female always lays her eggs in the nests of the species that raised her (unless none is available), and the same has been reported for several African cuckoos. In the African widowbirds (Viduinae), a brood-parasitic form of weaver finch, each species or subspecies parasitizes a particular species or subspecies of estrildine finch. Here the specialization goes so far that the nestlings of the brood parasites conform to the young of their hosts in appearance (for example, in their mouth markings, which form part of the releaser for regurgitation feeding) and behavior (in their begging calls), and the widowbird males pick up the entire vocal repertoire of the host males and use it as their own. Although such features as the mouth markings imply a degree of genetic adaptation, the host fixation appears not to be innate but to be acquired while the young brood parasite is being raised by its host. The early learning phase and the manifest stability of the preference consequent on it conform to the two main characteristics of imprinting, so the term "host imprinting" appears to be appropriate. However, no experiment has tested whether the fixation is consistent with other connotations of the term. (IB)

Huddling. Contact behavior. (IB)

Human ethology. A special and recent branch of ethology which endeavors to examine human behavior with the aid of methods that have been used in the study of animal behavior from an ethological point of view. Human ethology tries to elucidate the phylogenetic bases of human

behavior and to determine with the help of a comparative study of cultures, the innate components of these complex behavior patterns.

Hybrid. A progeny resulting from hybridization.

Hunger. The bodily sensation which appears under condition of food deprivation and which results in the desire and craving for food. (DM)

Hunting. An aspect of predatory behavior involving an animal of one species, the predator, capturing a member of another species, the prey. (DM) May also refer to the active pursuit of prey after sighting.

Hybrid breakdown. A hybrid is fully viable but is selected against because of its phenotype.

Hybridization. The crossing of individuals from two dissimilar populations or species. (D)

Hybrid sterility. The sterility of hybrids, usually a consequence of failure of meiosis.

Hypermorphosis. Exaggeration of the features of a descendant form compared to those of its ancestor due to an increase during evolution of the duration of ontogenetic development. (F) Specifically peramorphosis due to an increase in the endpoint of development.

Hyperphagia. overeating.

Hypnosis. See immobility.

Hypothalamus. The ventral part of the anterior division of the brain stem (forebrain, diencephalon) in vertebrates. It contains areas involved in the regulation of such functions as eating, drinking, and reproduction. For example, neurosecretory cells in the hypothalamus regulate the output of hormones from the pituitary gland and thus affect the gonadal, thyroid, and adrenocortical functions, as well as exerting more direct effects through production of prolactin, oxytocin, and other hormonal substances. (IB)

Hypothesis. An assertion or working explanation that leads to testable predictions: an assumption providing an explanation of observed facts, proposed in order to test its consequences. [LBC]

Ichnospecies. Species which are defined on the basis of trace fossils only.

Iconic display. Signals that resemble their object or meaning. (see indexic and symbolic)

Ideal Free Distribution. Competitors adjust their distribution in relation to habitat quality so that each individual enjoys the same rate of acquisition of resources. This assumes that animals are free to go where they will do best and that the animals are ideal in having complete information about the availability of resources.

Identical by descent. Describes copies of an allele that may be traced back through an arbitrary number of generations without mutation to a common ancestor of the organisms that carry the copies. (F)

Idiopathic. pathologic state of unknown cause [HWS]

Idiothetic orientation. Orientation in the absence of external stimuli such as the ability of an animal to orient in space without using external cues.

IEC. International Ethological Conference.

Imitative behavior. An animal is placed in the environment of another animal. If the first animal then makes some response that is not species-specific, and thereafter the second animal makes the same response under conditions when it can be demonstrated that the response of the first animal is the stimulus for the response of the second, then the second animal is said to imitate the first and the behavior is called imitative. (V)

Immobility. Tonic immobility (sometimes referred to as hypnosis) is a defensive freezing response of animals when faced with a predator or other traumatic event. This is an important aspect of their camouflage. (DM)

Immunological distance. The cross reactions of antibodies to the proteins of a specific serum. If antisera are not produced then the protein is considered more distantly related than if there is a weak or strong reaction. (also called antigenic distance).

Impaling. Behavior shown by shrikes and a few other species in which they attach food to sharp objects in the environment such as thorns or barbed wire. (mH)

Imprinting. Lorenz described the phenomenon of imprinting and emphasized several criteria which distinguished this learning process from other forms of association learning. (1) Imprinting takes place only during a specific sensitive period and if this period passes the animal can no longer be imprinted. The acquired knowledge of an imprinted object is retained for life and often affects sexual preferences when mature. (2) The operation of visually presenting to an individual large (and usually noisy) moving objects (exclusive of members of its own species) during the first hours of its life. Imprinting is said to have occurred if, and only if, the individual subsequently exhibits toward the large moving object (and objects like it) the behavior ordinarily exhibited only toward members of its own species. (3) A process hypothesized to account for imprinting in terms of perceptual theory. (4) Any learning that strikes someone as 'like' imprinting. (V)

Inbreeding. A pattern of mating in which matings between related individuals are more frequent than expected under random conditions. (D)

Inbreeding coefficient. F, the probability that an allele present in a common ancestor is homozygous in the inbred individuals. (BC)

Inbreeding depression. Reduction, as a consequence of inbreeding, of the mean value of a character. (F)

Incentive. A type of motivation that derives from expectation of reward or punishment. When an animal has learned a particular task to obtain a food reward, for example, it will perform more strongly when its expectation of reward is high. (DM)

Incest avoidance. A general term for mechanisms that obstruct mating between closely related individuals and so prevents the negative consequences of inbreeding. (IB)

Inciting. The most widely distributed courtship behavior in female ducks. The female orients towards her partner or her prospective mate, follows him and threatens at the same time towards another conspecific male. In communally courting species this behavior serves to isolate a male

from the group and stimulate him to become aggressive against other conspecific males. The behavior is also found in already established pairs. (H)

Inclusive fitness. The sum of an individual's own fitness (direct components) plus all its influence on fitness in its relatives (indirect component) other than direct descendants; hence the total effect of kin selection with reference to an individual. (W)

Incubation. Of birds, sitting on eggs.

Independent variable. In an experiment, the condition manipulated by the experimenter who measures its effect on the dependent variable. (IB)

Indexic display. signals that point out their objects, e.g., the stickleback nest presentation display. (see iconic and symbolic)

Indirect fitness. The long-term reproductive success of an individual through their kin other than offspring. The component of inclusive fitness that arises from effects on non descendent kin and other non descendent co-gene-carriers. Direct effects are attributed to individuals who physically transmit their genes through their own gametes, usually to the affected individual; indirect effects are not mediated in this way and do not require the production or transmission of gametes by the individual. See Brown (1980)

Indirect head scratching. The scratching pattern in birds in which the wing is dropped and the birds raises the ipsilateral leg over and above it to scratch the head. In contrast to direct head scratching. (H)

Indirect selection. The process that occurs when individuals differ in their effects on the survival of nondescendant kin, creating differences in the indirect fitness of the individuals interacting with this category of kin. [JA]

Indirect spermatophore transmission. A number of terrestrial animals have evolved ways to effect fertilization without copulation. Lacking copulatory organs, the males of these species convey spermatophores indirectly by depositing them on the ground and then inducing the female to pick them up in such a way as to achieve fertilization. This mode of sperm transmission has evolved independently many times in animals living on relatively moist substrates, where desiccation of the spermatophore is unlikely. In vertebrates, it occurs in some species of salamanders, and among invertebrates, in many arthropods, including myriapods, scorpions, whip scorpions, spiders, mites, and apterygote insects. (IB)

Individual distance. The minimum distance tolerated between individuals under normal social conditions; this distance is characteristic of the species but may show some variation depending on circumstances. (H)

Individual fitness. The sum of an individual's own fitness; the survival and reproductive output of an individual. (= Darwinian fitness)

Individual recognition. Personal recognition between individuals.

Individual selection. Natural selection at the level of the individual where individual fitness is maximized. A form of natural selection consisting of non-random differences among different genotypes within a population in their contribution to subsequent generations. (F)

Industrial melanism. A dark morph resulting from selection, where the selective pressure is associated with industrialization and the associated blackening of the environment with soot and smoke.

Inertia/behavioral. Continuation of a response after the stimuli for it are withdrawn. (V)

Infanticide. The killing of infants.

Infantilism or infantile behavior. A return to juvenile behavior patterns by adult animals especially in connection with courtship or submissive gestures. (H)

Information. In the study of animal communication this term is used in two ways. (1) In the quantitative sense of cybernetic information theory, equivalent to the notions of uncertainty and entropy as defined for that context. (2) In the more everyday sense in which information can be classified, restricted, public, sought after in reference books, or stolen by spies. A claim to information in the first sense is open only to the question "How much?"; in the second sense, such a claim might lead to the question "What about?" or the request "Do tell." These two senses are related, but confusion may result if it is not clear which sense is applied in a particular instance. Ethologists have to be explicit when they use the term, and readers must be on their guard when they encounter the term unattended by such explicitness. (IB)

Information centers. An hypothesis explaining the formation of social groups in which group members derive information about the location of food or limited resources by participating in this group. (HJB)

Information theory. Communication theory. Part of the science of cybernetics. The theory was developed based on the mathematics of signal transmission efficiency in telecommunications systems and they was found to be applicable in the whole field of communication studies, including animal communication. It treats information as a statistically defined quantity whose value depends upon the variety of alternatives from which the signal is drawn and the probability of the signal's occurrence. Amount of information is given by the expression

$$H = n \sum_i p_i (-\log_2 p_i)$$

where H is the amount of information in bits (Binary digits), n is the number of options, and p_i is the probability of occurrence of the i th option. This is a precise formal way to express such intuitively obvious considerations as that the word "the" tells us little compared with the word "ethology". The quantitative treatment of information and communication has refined certain kinds of comparisons of the communication capacities of different kinds of animals, and of the signal capacities of different modes and channels of signal transmission. . (IB)

Infostering. A part of an experimental design in which young are reared by individuals of the same strain but not their own parents. [HJB] see cross fostering

Infrared or IR light. The wavelength of electromagnetic radiation that is associated with our sensation of heat. (HJB)

Infrasound. Sounds at frequencies below the range of human hearing. (HJB)

Ingestive behavior. eating including suckling and drinking

Inhibition. The suppression of a condition or state; the hindrance or interruption of a process. Ethological inhibition refers to blockage of a behavior pattern through certain endogenous or allochthonous stimuli. (H) (1) A hypothetical state of the animal sometimes used to account for decrements in response magnitude, or habit-strength, or both. (2) A cortical process opposite to excitation and postulated as having the property of suppressing excitation and, hence, of suppressing the behavior dependent on that excitation. (3) A block. (V)

Initiation codon. Code (generally AUG) for the first amino acid in protein sequences which is generally formylmethionine. (S)

Innate. Much of animal behavior is innate in the sense that it inevitably appears as part of an animal's repertoire under normal and natural conditions. Genetic factors are necessary for such behavior but the species-characteristic processes of maturation and learning may be just as important. The naive dichotomy between nature and nurture which has characterized so much of the debate about innate behavior bears no relation to the complex and subtle interactions between the various processes that are responsible for the development of behavior patterns. (DM) (1) Refers to behavior not learned or acquired during ontogeny; behavior that is present at birth but not necessarily functional, or behavior that may appear only in the course of ontogenetic maturation. (H) (2) A term applied to differences in genetic characters between two members of the same species that have been raised in the same environment.

Innate releasing mechanism (IRM). all those hypothetical structures of the CNS of an organism which have an important part in eliciting the reaction, but does not include the motor system. An IRM may either originate through ontogeny or phylogeny. (H) A hypothetical physiological "neurosensory" mechanism invoked to explain the action of sign stimuli. (V)

Innovation. Inventive or new behavioral combination.

Inquilinism. Interspecific relation in which a socially parasitic species of an insect spends its entire life cycle in the nests of its host species. Workers either are lacking or if present are usually scarce and degenerate in behavior. (H)

Insemination. Introduction of sperm into reproductive tract of female. (IB)

Insight. Ethologists speak of insight when an individual is able to master a new situation or task without the help of pre-programmed innate responses and without previously having attempted the solution. (see aha experience). (H) A gross difference in behavior between two successive occasions on which behavior can occur, when the behavior shown on the second occasion is close to what the experimenter has previously decided upon as a "good" or "efficient" solution. (V)

Instantaneous speciation. The production of a single individual that is reproductively isolated from the species to which the parents belong and is reproductively capable of establishing a new species population. (M)

Instinct. Tinbergen regarded instinct as a hierarchically organized nervous mechanism which reacts to priming, releasing and directing stimuli of either endogenous or exogenous character. The reaction consists of an adaptive, coordinated series of movements. Tinbergen distinguished primary and secondary instincts. Today the instinct concept has become controversial and obsolete. (H) (1) A class or set of responses shown by most members of a species. Many of the responses can be demonstrated as dependent on highly specific stimuli in the environment. Such a class is empirically demonstrated by showing that certain responses are statistically organized (i.e., associated together in time) under specified environmental conditions and following a single set of drive operations, when there have been experimental manipulations calculated to prevent learning. (2) Same as above but without any qualification with respect to experimental manipulations

calculated to prevent learning. (3) Hypothetical system of hierarchically organized centers postulated by Tinbergen to account for observable instances of instinct: "A hierarchically organized nervous mechanism which is susceptible to certain priming, releasing and directing impulses of internal as well as of external origin, and which responds to these impulses by coordinated movements that contribute to the maintenance of the individual and the species."

Instinctive behavior. A behavior sequence involving inherited pathways of the central nervous system. Such sequences are no more subject to modification than are morphological traits of the individual.

Instrumental conditioning. (1) Operant conditioning. (2) A term applied to operant conditioning when the animal is not free to give the response except when the experimenter chooses. (V)

Integration and excision. Integration: a recombination in which a genetic element is inserted; excision: genetic element deleted. (S)

Intelligence. (1) The ability of animals to learn. (2) The ability of animals to use insight learning. (HJB)

Intensity of response. With a constant stimulus but under increasing values of variables involved in drive-establishing operations, or vice versa, a response may not only increase in magnitude but may alter in topography as well. Positions along such a graded continuum are referred to as different intensities of response. (V)

Intention movement. (1) An incipient or partial act of a sequence of an innate behavior pattern which contains information to a conspecific in that it indicates the readiness to perform a specific behavior. Can arise in a conflict situation. (mH) Today this refers to any incipient or preparatory action whether learned or not. (H) (2) If an instance of a response that is a member of a behavior chain occurs usually, but not necessarily, in association with instances of other members of the same chain, it is termed an intention movement with respect to later members of the chain. (V) Also called anticipatory behavior.

Interaction. In a statistical sense, a joint effect of two independent variables ("causes") on a dependent variable, whereby the effect differs from the sum of the two causal effects taken separately: synergism. Genotype x environment interaction is consequently variation in phenotype arising from the difference in the effect of environment on the expression of different genotypes. (F) This term is used in several ways in ethology. (1) Most often it refers to an encounter between animals in which each responds to the presence of the other. Signals may be exchanged, or one animal may withdraw at the other's approach; such mutual stimulation and responding as occur in courtship, agnostic behavior, parental care, and so forth exemplify interaction in this sense. (2) An animal is sometimes said to show interaction with its environment, in which case the influence is usually more one-sided; the environment affects the animal more than the animal affects the environment. (3) In statistical analyses a third and more technical usage is current: in an analysis of variance a portion of the variance may be due to the joint effects of two or more factors over and above that due to their independent effects, and this is called an interaction. (IB)

Interdemic selection. Group selection of populations within a species. Differential success of demes because of their genetic properties. Success is achieved by reduced extinction in some models (Wynne-Edwards, 1962) and by greater colonization in others (Wright, 1945). See deme.

Interneuron. A neuron that connects two neurons, such as from a sensory neuron to a motor neuron.

Interoceptor. A sensory receptor activated by stimuli occurring inside the body, e.g. proprioceptors [HWS]

Intersexual selection. Female or male choice of mates.

Interspecific. Between different species.

Interspecific territoriality. Territoriality directed to non conspecifics.

Interval data. Numbers that have been derived along a continuous scale with a real zero point.

Intervening sequence. A portion of a gene that is transcribed but does not appear in the final mRNA transcript. (S)

Intrinsic rate of natural increase. The potential rate of increase of a population, r , with a stable age distribution, whose growth is not depressed by the negative effects of density. (F)

Intimidation. Effective threat.

Intrademic selection. Selection within a deme, in contrast to interdemic selection.

Intrasexual selection. Competition between males (or females) for mates.

Intraspecific. Within a species.

Intrinsic rate of natural increase. The potential rate of increase of a population, r , with a stable age distribution, whose growth is not depressed by the negative effects of density. $r = b - d$ where b is the birth rate and d the death rate. (F)

Introgression. The incorporation of genes from one species into the gene pool of another. (D)

Introgressive hybridization. Breeding of individuals from two different species which results in introgression. (D)

Intromission. The intromittant organ or pair enters the reproductive tract of the female, but no ejaculation occurs.

Intromittant organ. The organ of sperm transfer in internally fertilizing species. In mammals this is the penis; in fish the gonopodium.

Intron. Intervening sequence in DNA. (S)

Inversion. A 180° reversal of the orientation of a part of a chromosome, relative to some standard chromosome. (F)

Investment. Refers specifically to time or resources donated to one individual (for offspring called parental investment) which take away from the donors ability to donate such time or resources to others in the future.

Iridium. Heavy element not normally present in the rock of the earth's crust but is common in meteors.

Irrelevant behavior. While the animal is performing one kind of behavior it may suddenly break off and do something completely different and apparently not appropriate to the context. These are normally classified as displacement activities. (DM)

Irritability. The ability of all living organisms to react to influences from the external environment with a particular response.

Irritable aggression. Animals that are in pain or uncomfortable have a lowered threshold for aggression. [BB]

Isogamy. Male and female gametes are the same size.

Isolating mechanisms. Any structural, physiological, behavioral or other feature of an individual, or any geographical or geological barrier, that prevents individuals of one population from successfully interbreeding with those of other populations. (D)

Isolation experiment. Also referred to as experience deprivation and deprivation experiment. Deliberate withholding of certain possibilities of experience in the rearing of an animal. With this method one can determine which capabilities develop normally, even in the absence of what might have appeared relevant experience, and what deficits go with what kinds of deprivation. Evidence from isolation experiments has been the basis of inferences about the components of a species' behavior that are innate, but this is a controversial matter. Inference from an experiment with experience deprivation is possible in only one direction: if the behavior of a deprived animal turns out to be normal, one can conclude that the experience withheld is not necessary to development of that behavior. But if development is abnormal, the reverse conclusion does not necessarily follow, because the deficits could also be the result of unnatural features in the circumstances of the isolation experiment. (IB)

Isometry. When the growth of one part of the body is exactly proportional to growth in another part of the body or to overall body size. (see allometry)

Isozyme. (isoenzyme) One of several forms of an enzyme, produced by different nonallelic loci in an individual organism's genome. Often misused in place of allozyme. (F)

Itch. An irritating sensation that arouses motivation to scratch, rub or bite the affected area of the body. [HWS]

Iterative evolution. The repeated evolution of similar phenotypic characteristics at different times during the history of a clade. (F)

Iteroparous. Used of organisms that have repeated reproductive cycles (see semelparous).

Joint nesting. A system of nesting in which two or more females of the same species normally lay their eggs in the same nest. In communally breeding species the joint-nesting females of the same species normally lay their eggs in the same nest. In communally breeding species, the joint-nesting females of the same species normally take the care of the young (thus excluding egg parasitism). (See also communal nesting). (Brown 1987).

Jump. To spring from the ground or surface with the propulsive force being derived primarily from the action of the legs. [HWS]

Jumping genes. Genes associated with transposable elements. (S)

Jurassic. A geological period of the Mesozoic era 210-140 my ago.

Juvenile behavior. The behavior of young individuals. Like adult behavior, juvenile behavior is subject to natural selection and often differs from the behavior of adults due to the different requirements of young individuals. (DM)

K. Carrying capacity.

K-selection. Selection that favors organisms producing few offspring, each with a relatively high probability of survival; often associated with high competitive ability, long lifespan, slow development, late reproduction and poor dispersal ability. (cf. r-selection).

Kairomone. Any substance or blend of substances emitted by an organism that elicits a response adaptively favorable to the receiver but not to the emitter.

Karyotype. The appearance of the metaphase chromosomes of an individual or species; comparative size, shape, and morphology of the different chromosomes. (G)

Kasper-Hauser experiment. Refers to rearing animals in isolation from conspecifics from a very early age (isolation or deprivation experiment). Whatever the animal performs is therefore not attributable to imitation or learning from other conspecifics. The German term Kaspar-Hauser is derived from the name of a youth in Nuremberg discovered at 17 years of age unable to speak, nearly unable to walk, shy of light and accustomed to only water and bread. After learning to speak he supposedly said that he only remembered a dark room where he would awaken to bread and water having never seen other humans. (H)

Key stimulus. The stimulus which is adequate to activate an innate releasing mechanism which then sets in motion a species specific action pattern. The term is based on the idea that the releasing cues of a behavior are analogous to a key which opens a lock.

Kicking. The act of delivering a powerful blow with one or both hind legs. [HWS]

Kin discrimination. The selective treatment of members of the same species in a manner linked to the degree of genetic relatedness between the interacting individuals.

Kin recognition. An animal's ability to differentiate between relatives and nonrelated conspecifics. It is known to occur in high vertebrates, especially mammals and birds, and also sporadically in invertebrates (desert wood lice, honeybees). It may include personal recognition of single individuals; collective recognition of members of a genetically related group by some mechanism such as group odor or hive odor; or phenotype matching, in which an animal distinguishes between others on the basis of similarity to itself. See also phenotype matching. (IB)

Kin selection. A form of genic selection whereby alleles differ in their rate of propagation by influencing the survival or reproduction of individuals (kin) who carry the same alleles by common descent. (F)

Kinematic diagram. A diagram showing the sequencing of behavior and giving the transition frequencies (or probabilities). (HJB)

Kinesis. Refers to an orientation behavior which depends on the stimulus intensity but not on the direction from which the stimulus is perceived. (H)

Kinesthetic sense or kinaesthesia. Sensations of movement and body position an animal's perception of its own movement and posture. Also called idiothetic sense.

Kinopsis. Individuals of a group are attracted to other group members by visual perception of their movement. [HWS]

Kleptogamy. Sneaky or stolen matings.

Kleptoparasite. An animal that steals food gathered by another animal.

Kleptoparasitism. The stealing of food. Usually refers to interspecific food thievery. (HJB)

Klinokinesis. Refers to kinesis orientation behavior in which the turning rate changes under different conditions. (H)

Klinotaxis. A simple type of orientation behavior in which the animal makes successive comparisons of the intensity of a stimulus on one side of the body and then on the other. (V)

Kurtosis. A deviation from the shape of the normal frequency distribution. [HWS]

I_x . Survivorship; the proportion of females surviving to age x . (WB)

Labile. Of a character that changes frequently or readily over evolutionary time.

Lamarckism. The belief that patterns of resemblance among organisms arise through evolutionary modification where animals that resemble each other most closely have close common ancestors. However, the mechanism by which modifications occur is the direct calling forth of adaptive responses in animals which are then inherited by their offspring; inheritance of acquired characteristics. (AV)

Landmarks. Conspicuous natural objects which are useful for optical orientation.

Language. To qualify as language, a communication system must be culturally transmitted and symbolic; to some it must be capable of encoding abstract ideas. (DM)

Larder hoarding. The hoarding of food in a central and mass location. The accumulation of food in one mass location. (HJB) In contrast to scatter hoarding.

Latency of response. The measure of time elapsing between the onset of a stimulus and the beginning of the response to it. (V)

Latent learning. (1) Under some conditions, without either ostensible presentation of a reinforcing stimulus or the occurrence of the response whose strength is altered, changes in the magnitude or relative frequency of a response may be observed. If such changes can be observed, they are termed latent learning. (2) Acquisition in the absence of ostensible reinforcement. (3) A process hypothesized to account for the empirical observation above. (V)

Lateral inhibition. See receptive field.

Lateral recumbency. Lying characterized by full lateral contact of the body trunk, neck, head and legs on one side with the ground. [HWS]

Laughing. An expression common to all humans indicating a friendly intention but may also represent mild aggression.

Laurasia. The northern subcontinent formed by the breakup of Pangea about 150 my ago.

Law. An empirical generalization; the statement of a biological principle that seems to be without exception [LBC]

Law of Analogy. A generalization by E. Thorndike stating that organisms respond to a new situation as they have initially responded to similar situations in the past. [HWS]

Law of Heterogeneous Summation. A generalization stating that independent components of a compound stimulus have additive effects on the behavioral response of an organism. [HWS]

LD Cycle. A cycle of alternating light and dark periods over a day; LD 16:8 means 16 hours of light alternating with 8 hours dark. [HWS]

LD-50. A dose of substance that is lethal to the median (50%) of all organisms of a given species or type. No longer considered a useful way of testing. [HWS]

Learn. To exhibit a change in behavior between two successive exposures to the same environment that cannot be attributed to manipulation of drive operations, alterations in the environment, sensory adaptation, disease, surgical interference, physical trauma, or growth--although the propriety of these exclusions may be questioned. (V)

Learned helplessness. A phenomenon that may occur when avoidance or reduction of some aversive stimulation is impossible or extremely difficult for the subject to avoid. Characterized by passive acceptance of the aversive stimulus. [HWS]

Learned preference. Any preference influenced by a conditioning process. [HWS]

Learning. A broad concept which includes information uptake, storage, retrieval. (1) A process or family of processes inferred from the observation that animals learn. (2) A generic term for conditioning. (3) Those behavioral processes determining how the genotype is expressed in the phenotype. (V)

Learning curve. Graphic illustration of changes in an animal's responsiveness to the learning process; arranged by consecutive trials. [HWS]

Learning set. Mental representation of a principle common to a series of learning trials such that although circumstances may differ between trials, the solution to each is governed by the common principle. An animal is considered to have acquired a learning set when it apprehends the principle. [HWS]

Lee-boot effect. Suppression of initiation of estrous behavior by over-crowding of animals. [HWS]

Lek. Sites where males congregate for social courtship displays and fighting. The females come to these sites for mating. The area defended by individual males within a lek or communal display area is not used for feeding and is usually quite small. (H) Refers to the location of a traditional mating ground in a species with a lek mating system (called lekking). A lek mating system is one in which there are no permanent pair bonds and no paternal care, where females mate with males at particular locations where they defend small display territories.

Lesion. In ethology and physiology, deliberate destruction of neural tissue for experimental purposes, as by surgical severing of a nerve tract in the brain. (IB)

Lestobiosis. The relation in which colonies of small species of social insects nest in the walls of the nests of a larger species and enter the chambers of the larger species to prey on brood or to rob the food stores.

Lethal. A lethal mutation or aberration causes the death of the individuals possessing it; those that can be studied genetically are lethal only when homozygous. (D)

Licking. An action whereby the tongue is slid over the surface of an object. Licking may have a nutritional, gustatory, prophylactic or social function; may be self directed or social. [HWS]

Life-history strategy. A selected set of adaptations to local environments, involving such quantitative aspects of life history as fecundity, the timing of maturation and the frequency of breeding. (SG)

Lignophagia. eating wood. [HWS]

Limb flicking. A behavior of cats when they get their paws wet. Each wet limb is quickly shaken in turn. [BB]

Lineage. Line of descent. (SS)

Linkage. The occurrence of genes on the same chromosome. The closer they are on the chromosome, the more tightly they are linked, that is, the less likely they are to segregate independently during meiosis. (mM)

Linkage equilibrium and Linkage disequilibrium. If two alleles at two or more loci are associated more or less frequently than predicted by their individual frequencies, they are in linkage disequilibrium; if not, they are in linkage equilibrium. (F)

Lithosphere. Solidified rock surface or outer shell of the earth.

Light compass reaction. Locomotion at a temporarily fixed angle to light rays.

Lip-curling. see flehmen

Lloyd Morgan's canon. "In no case may we interpret an action as the outcome of the exercise of a higher psychical faculty, if it can be interpreted as the outcome of one which stands lower in the psychological scale" (Lloyd Morgan 1894). In reaction largely to the anthropomorphism of his contemporaries in their interpretations of animal behavior, Lloyd Morgan took a tough-minded stance, that of adopting the minimum postulate sufficient to account for an animal's actions. Behaviorists then applied this notion with even more reductive force than Lloyd Morgan. His canon is still generally followed, even though there is no guarantee that this is the simplest of all possible worlds as far as control of behavior is concerned. (IB)

Local enhancement. An animal's directing of attention toward some object or place in its environment as a consequence of observing how others act with regard to that object or place. Thus many animals find their way to a source of food more quickly if they see others looking for that place. Like social facilitation, local enhancement is to be distinguished from imitation. Each animal finds its own way by trial and error, even though the process is facilitated by observing other animals. (IB)

Locomotion. Voluntary movements which displace the whole body of an organism. (DM)

Locus. (plural loci) The location of a given gene on a chromosome. (M)

Logistic equation. A specific equation describing the idealized growth of a population subject to a density-dependent limiting factor. (F)

Logistic growth. A pattern of population growth in which the growth rate decreases with an increasing number of individuals (S-shaped curve). (BC)

Long call. In gulls a demonstrative behavior with accompanying vocalization. In the herring gull the sequence occurs in three parts and consists of stretching the head first forward under the breast then backward while uttering a few high notes, then the head is jerked upward, a series of loud sounds are emitted followed by thrusting the neck and wide open beak forward. (H)

Lordosis. The posture adopted by many female mammals before and during copulation. Can be elicited by tactile stimulation. (IB)

Lunar periodicity. In many marine animals living in the tidal zone, the reproductive cycles are limited to the periods of spring tide and may coincide precisely with the moon phases.

Lying-out period. In ungulates the young will actively leave the mother after nursing and hide, concealed until called by the mother.

M_x . The fecundity at age x ; specifically the average number of daughters each female will produce at age x . (WB). The forward mutation rate; the fraction of a given allele that mutates in each generation to a second given alleles. (WB)

m . The migration rate and population genetics; the fraction of a population that consists of individuals that immigrated to it from other populations. WB)

Macroevolution. A vague term for the evolution of great phenotypic changes, usually great enough to allocate the changed lineage and its descendants to a distinct genus or higher taxon (F); evolution above the species level. The study of evolutionary events and processes that require long times for their occurrence or operation. (F) (SG)

Macromutationism. A theory that new taxa evolve essentially instantaneously via a major genetic mutation that establishes reproductive isolation and new adaptations all at once. (SG)

Magma. Molten or partly molten rock material. (WS)

Magnetic field orientation. Animal orientation using the earth's magnetic field. (H)

Magnitude of response. Term applied to any one of several descriptive measures of a response, including amplitude or duration, latency or velocity of response, or of a temporally restricted set of responses (such as frequency, relative frequency, percentage of occurrence), or rate of response, which state quantitatively the likelihood that a response will occur under stated conditions during that brief span of time. (V)

Maintenance activities. Behavior patterns and movements that serve to enhance the animal's comfort and body care including cleaning movements, self-shaking movements, self rubbing, bathing movements, stretching, scratching and yawning and defecation. (H)

Maladaptive behavior. Any behavior that causes a reduction in fitness. [HWS]

Male care. Parental care performed by males.

Male choice. Non-random mating by males. (HJB)

Male parasitism. The permanent attachment of a male to a female.

Manipulation. The action of an organism which reduces its fitness and increases the fitness of the recipient when the recipient is actually controlling the action. An interaction between two conspecifics in which the donor loses and the recipient gains but differs from altruism in that the recipient has behaved in a way that encourages the donor into giving.

Mantle. The shell of the earth below the crust and above the core; divided into 3 zones: the upper mantle (200-400 Ku) and the lower mantle (900 to 2900 Ku). (WS)

Map. The ability that an animal has to know where it is on the face of the earth when in an unfamiliar location. "That little voice" that tells an animal where it is and where it needs to go to reach home.

Marking. The designation of trails and delineation of a territory with chemical scents; chemically marking the mate or members of a social group. (H) Behavior used to call attention to an individual, area or object. It can take many forms including visual and chemical. [BB] Any deposition of scent compounds or other signs that serve to delineate territorial boundaries or trails or to designate partners and group members. [HWS]

Markov Process. A stochastic process where future development is determined only by the present state and is independent of the mode of development of the present state. Can refer to sequences of behavior.

Mass provisioning. The storage at the time of egg-laying of a food supply adequate for the entire larval development.

Masturbation. self-stimulation of the genital area. Most commonly seen in bulls, stallions, dogs and primates. [BB]

Matching. In bird song when individuals with more than one song in their repertoire imitate the songs sung by neighboring mates.

Matching Law. The proximate rule used by individuals of a population by which they achieve the ideal free distribution.

Mate choice or selection. Non-random mating among individuals of a species. (HJB)

Mate guarding. An epigamic behavior pattern in which one individual usually the male remains in close proximity to the female and keeps her from copulating with other males. In many species this is closely associated with the period of fertility.

Mate preference. The favoring of particular sexual partners over others. [HWS]

Maternal behavior. Care given by mothers toward their offspring.

Maternal effect. A nongenetic effect of the mother on the phenotype of the offspring, owing to factors such as cytoplasmic inheritance, transmission of disease from mother to offspring, or nutritional conditions. (F)

Maternal rejection. Social rejection of a neonatal offspring by their mother. [HWS]

Maternity certainty. The probability that a female is rearing her own young.

Mating behavior. Mating begins with the mount and ends with ejaculation. [BB]

Mating system. Categories for patterns of reproductive behavior. See monogamy, polygyny, lek.

Matrilineal. Passed from the mother to her offspring as, for example, access to a territory or status within a dominance hierarchy.

Maturation. In ethology maturation refers to innate behavior patterns which appear at a given point in the animal's life cycle without prior learning. Refers to an irreversible process of change that occurs as part of the total ontogeny of the animal. Maturation does not depend on experience and is thus distinct from learning and practice. (DM)

Mauthner cell. An giant neuron in the head of fish and related species that mediates the c-shaped escape or startle response. The cell receives innervation from the lateral line system and has projections to the trunk musculature.

Maze experiment. In T or Y maze experiment the animal learns the correct path at each choice point which eventually brings the animal to its goal. This goal is usually rewarded with food.

Mean. Usually the arithmetic mean or average; the sum of n values, divided by n. (F)

Measurement of response. The assignment of numbers to responses or to response-instances according to the rules of measurement. Measures include amplitude of response, (V) intensity of response, latency of responses, probability of response, rate of response.

Mechanical isolation. Reproductive isolation owing to the incompatibility of male and female genitalia. (M)

Mechanical senses. Mechanoreceptors are receptors that are sensitive to mechanical deformation. (DM)

Mechanoreceptor. Sensory cell that reacts to mechanical deformation.

Meiosis. A type of nuclear division in which the number of chromosomes is reduced to half. (D)

Meiotic Drive. Mechanisms by which some genes end up preferentially in the daughter cells at meiosis.

Meliferous. honey producing.

Meme. The unit of information transfer be it idea, belief or custom of cultural evolution (analogous to gene in genetical evolution).

Memory. The capability of the CNS to store information for subsequent retrieval. (H)

Mendelian inheritance. A theory of inheritance that states that the hereditary traits are carried in cells in the form of particles (genes). (D)

Menstrual cycle. Refers to the repeated pattern of periodic bleeding from the uterus and vagina which occurs in sexually mature women, in all species of apes and in some kinds of monkeys. (DM)

Meristic trait. A discretely varying, countable trait; e.g., number of digits. (F)

Mesozoic. An era of the Phanerozoic eon of earth history (WS); the age of reptiles; 245-65 my ago. (E)

Messenger RNA (mRNA). RNA that is synthesized using one strand of DNA as a template and that is then used to direct protein synthesis on ribosomes. (BC)

Metacommunication. A form of communication that conveys information about the interpretation of subsequent communications or signals. [LBC]

Metamerous. Of coelomic cavities, divided into regular, repeated segments separated (at least primitively) by septa; most such segments contain a complete set of the various internal organs. (AV)

Metaphor. A figure of speech in which a term is transferred from an aspect that it normally designates to an object or situation it designates by implied comparison.

Metazoa. Animals that include both coelenterates and platyhelminthes in their multicellular family tree; essentially all living multicellular animals except sponges. (AV)

Mew call. In the herring gull a long drawn-out tone given with the neck stretched forward and down with the bill wide open; serves as an enticement but may also express antagonism since it frequently follows a dispute on the territorial boundary. (H)

Microevolution. A vague term for slight evolutionary changes within species. (F) Processes of change within a species. (MF) Evolution due to changes in gene frequencies within local populations. (SG)

Migration. (1) Used in theoretical population genetics as a synonym for gene flow among populations; (2) in other contexts, directed large-scale movement of organisms that does not necessarily result in gene flow. (F)

Migratory restlessness or *Zugunruhe*. Activity of migratory birds held in captivity; a good measure of readiness to migrate.

Mimetic behavior. An animal is placed in the environment of another animal of the same species: if the second animal then makes some species-specific response, and thereafter the first animal makes the same response under conditions where it can be demonstrated that the response of the second animal is the stimulus for that of the first and that no opportunity for discrimination and differentiation training has been given to either animal, then the behavior is termed mimetic. (V)

Mimicry. Imitation, deception, disguise and protective adaptation to make an individual appear to be something it is not. (H) The superficial resemblance of one organism by another, presumably affecting the actions of predators of prey. (E)

Miocene. A middle epoch of the Tertiary period, beginning about 26 million years ago and ending about 11 million years ago. (E)

Mitochondria. Cytoplasmic organelles composed of two membranes, the innermost of which is convoluted; they are the site of many reactions of cellular respiration. (E)

Mitosis. The orderly processes through which the nucleus of the cell undergoes division in such a fashion that the daughter nuclei receive the same number of chromosomes as in the parent cell. (D)

Mixed species group. A group composed of more than one species. (IB)

Mixed strategy. More than one strategy is maintained in the population. (see ESS)

Mnemotaxis. Orientation according to memory; not in common usage. (V)

Mobbing. Aversive response by song birds to birds of prey in which they swarm around and pursue their enemy while giving typical calls and performing sham attacks. (H)

Modal action patterns. Recognizing that fixed action patterns always have some variability. Barlow argued that they should be referred to as modal rather than fixed. (HJB)

Model. Two totally different meanings. (1) A simulation of some natural object, such as a mannequin or decoy. These are stimulus objects used in behavioral experiments to determine the key stimuli, releasers, supernormal releasers or generally the effects of a stimulus object on the behavior of an organism. (2) An hypothesis or paradigm constructed for the purpose of testing a scientific idea. (H)

Modifier genes. Genes whose major obvious phenotypic effect is to modify the phenotypic expression of other genes. (E)

Molecular clock. When nucleotide substitutions occur at a set rate, as they do in non-functional parts of the DNA, then the number of nucleotide differences between two parts of a lineage can indicate the time since they diverged from a common ancestor. (see evolutionary clock)

Molecular drive. The fixation in a population of a variant sequence throughout a gene family.

Monogamy. A mating system in which male and female normally have only one mate and where there is a pair bond. Refers to a mating system in which animals have only one mate during a breeding season and form a pair bond. Usually associated with parental care.

Monogyny. In social insects refers to one queen per nest.

Monomorphic. A population in which virtually all individuals have the same genotype at a locus (cf. polymorphic). (F)

Monophyletic. A taxonomic grouping that contains all known descendants of an ancestral species. Species groupings based upon synapomorphies [Wil]

Monotypic family. A taxonomic family with one genus.

Monotypic species. A species that is not subdivided into subspecies (cf. polytypic species). (D)

Monozygotic twins. Twins that develop from a single zygote and thus have an identical genotype. (BC)

Morph. Any of the variant types of a polymorphic species. (D)

Morphocline. An ordered array of character states such that each state could plausibly be derived only from neighboring states in the array.

Mosaic evolution. Evolutionary change in one or more body parts without a corresponding change in others. (AV) Evolution of different characters within a lineage or clade at different rates, hence more or less independently of one another. (F)**Mood.** A hypothetical internal state of readiness to discharge a certain complex of behavior patterns.

Motivation. The motivation for a particular behavior is effectively the measured frequency or intensity with which the behavior occurs or generally speaking the probability of its occurrence under certain circumstances. This readiness to act depends on certain given internal factors as well as external stimuli. (H) Changes in responsiveness to a similar stimulus situation. (H)

Motivational change. In an evolutionary sense, a change in the underlying causal control of a behavior pattern in accordance with a change of function. Thus the courtship feeding of many birds corresponds in form to the manner in which parents feed their chicks. However, it has taken on a new function and consequently is no longer governed by the motivation underlying parental behavior, but by sexual motivation. The term is virtually synonymous with emancipation, except that the latter is usually restricted to causal change concomitant with ritualization and hence the evolutionary emergence of communication displays. (IB)

Motivational energy. Action specific energy or drive.

Motivational state. The combination of physiological and perceptual factors underlying an animal's behavior or impending behavior at a particular time. A recent conception pictures motivational state as located in a multidimensional space, the axes of which are formed by the relevant physiological and stimulus variables, whose values are affected by the consequences of an animal's activity. This way of representing and computing motivational state avoids some of the problems that confounded unitary conceptions of drive and motivation. (IB)

Motor component acts. The individual elements of an action pattern.

Mounting. Pre-copulatory behavior whereby an individual of one sex (generally the male) positions itself for copulation. (mH)

Mouth brooding. Fish, especially of the cichlid family in which the females take the eggs in their mouth following spawning and incubate them there. The fertilization of the eggs occurs in the mouth of the female by subsequent uptake of sperm. (H)

Mouth fight. Agonistic behavior pattern in fish using their mouth for fighting. Substrate nesting cichlids fight by grasping each other lip-to-lip, wrestling and shoving back and forth. (H)

Mouth play. The young of many species will play bite, nip or mouth body parts of others as they play. [BB]

Müllerian mimicry. Mimicry in which a series of dangerous or distasteful species resemble one another. (E)

Multiparous. females that have undergone more than one cycle of pregnancy and parturition. (see primiparous) [HWS]

Mutagenic agent. An agent leading to an increase in mutation rate above the spontaneous level at a locus. (E)

Mutation. A change in a gene; sometimes applied also to chromosomal changes. (E) An error in replication of a nucleotide sequence, or any other alteration of the genome that is not manifested as reciprocal recombination.

Mutation pressure. Changes in allelic frequencies in a population due to mutation.

Mutation rate. The frequency of mutations per generation at a given locus.) (BC)

Mutualism. An interaction between two organisms (conspecifics or heterospecifics) which benefits (increases the reproductive success of) both interactants. A relationship between two or more individuals or species in which both parties benefit. Normally benefits are measured by their net effects on direct fitness. (Brown 1987).

Myelin. A layer of cells that cover nerve fibers and increase conduction velocity.

Myrmecophilous. Living in association with ants.

Myrmecophagous. Eating ants.

N. sample size; the number of organisms in the population, population size. (WB)

Nape bite. (a) A bite directed at the dorsal neck; it can be an inhibited bite that does not penetrate the skin, such as that associated with tomcats, dogs and stallions during mating. (b) directional killing bite of a cat on its prey. The bite is aimed at a constriction between two head and shoulders and results in severing the spinal cord. [BB] see neck bite

Natal. Refers to birth, as in natal sites or birthplace.

Natural selection. The differential change in relative frequency of genotypes due to differences in the survival and reproduction or fitness of phenotypes or genetic types.

Naturalistic fallacy. The erroneous belief that what is found in nature is right or morally justified.

Navigation. The ability to orient toward a goal (e.g. home) regardless of its direction by means other than recognition of landmarks. (DM)

Neck-bite. (1) In a variety of mammals and birds the male bites the female's neck during copulation. (2) Similar movements occur in many predators when they attack their prey. (3) This type of neck bite also resembles the grip used by certain mammals and rodents when carrying their young. see nape bite.

Nectar guide. The lines on a flower that lead to the location where an insect may obtain nectar from that flower.

Necrophagic. Feeding on dead organisms.

Necrophoresis or necrophoric behavior. Transport of dead members of the colony away from the nest in social insects.

Need. A state of physiological disequilibrium and of departure from homeostatic balance. (V)

Neophobia. A fear by animals of unfamiliar objects or situations. (HJB)

Nebula. Interstellar cloud of gas and dust. (WS)

Negative feedback. A dynamic relation whereby the product of a process inhibits the process that produces it, usually enhancing stability. (F)

Neo-Darwinism. The addition of modern genetics to Darwin's theory.

Neo-Lamarckism. A popular late 19th century alternative to Darwinism, postulating that adaptations arise as characters acquired by active organic responses to environments and are passed on to offspring by heredity. (SG)

Neonatal. newborn

Neontology. The study of recent organisms. (M)

Neoteny. Slowing down of development over evolutionary time where animals become sexually mature before it is physically grown.

Nepotism. The preferential donating of care of resources to close relatives. (HJB)

Neritic. Refers to sediments deposited on the continental shelf.

Nerve impulse. Action potential.

Nest-building behavior. The construction of a nest. (DM)

Nest relief ceremony. A display which is associated with the transfer of the nest brooding or guarding from one partner to the other (found in many bird species with biparental care). (H)

Neural transmitters. Substances which are released upon stimulation of a neuron at the nerve endings (with synapses) and which aid in the transmission of stimuli by means of changes in the permeability of the membrane. (H)

Neuroethology. The study of neural processes and sensory reception that underlie and control behavior.

Neuron. Nerve cell.

Neurotransmitter. A chemical that is released by one neuron and affects the probability that the next cell in the network will fire. [JA]

Neutral theory of evolution. A theory proposed by Kimura that molecular variation (variation in allozymes) arises through mutations, that is selectively neutral and that differences in the amount of variation result from genetic drift (see neutralist or neutral mutations).

Neutralist. Differences in amounts of variation are due to differences in population size, numbers of individuals and mutation rates (cf. selectionists).

Neutral mutations. Mutations which have no selective effect or no effect on the phenotype. (B)

Niche. The range of each environmental variable, such as temperature, humidity and food items, within which a species can exist and reproduce. The preferred niche is the one in which the species performs best, and the realized niche is the one in which it actually comes to live in a particular environment. (W)

Nidicolous. Altricial Bird chicks that remain in the nest for extended periods of time and are dependent on parental care. [BB]

Nidification. nest building

Nidifugous. Baby birds that are generally well developed when hatched and rely on their parents primarily to lead them to food. [BB]

Nod swimming. An epigamic behavior found in several dabbling ducks originally referred to as "coquette" swimming.

Nominal data. Refers to categorizing or grouping observations into definable categories when there is no underlying scale, e.g. number of responses to red, green and yellow stimuli. If the stimuli were light, medium and dark then there would be an underlying scale even if it was not known to the observer, i.e. the stimuli could be ordered. These would be ordinal data.

Nondescendant kin. Relatives other than offspring. [JA]

Nondisjunction. Failure of the chromosomes to separate at the first meiotic anaphase. (E)

Nonparametric statistics. Statistics that do not depend on any particular underlying distribution.

Norm of reaction. The set of phenotypic expressions of a genotype under different environmental conditions. (F)

Novelty. An unfamiliar object or situation. (DM)

Nuclear family. A family consisting of the mother, father, and their offspring but not including grandparents, grandoffspring, or other kin.

Nucleic acids. Complex acids composed of nucleotides. (E)

Nucleotide. A phosphate ester of the N-glycoside of a nitrogenous base; chemical building block of a nucleic acid. (E)

Nucleotide replacement site. Position in a codon where a point mutation has occurred. (E)

Null hypothesis. Used in statistics; the hypothesis that there is no difference between two treatments.

Nulliparous. referring to females that have not yet given birth to viable offspring. [HWS]

Nuptial flight. The mating flight of the winged queens and males of social insects butterflies and other insects where mating includes flight.

Nuptial gift. A food item transferred by a male to a female just prior to or during copulation.

Nurse. The behavior of female mammals in feeding milk to her young.

Odor Signature. The odor produced by an individual organism.

Offspring rule. When a behavior in question (usually altruistic) will be favored by selection:

$$\begin{array}{l} B \text{ gain to recipient} = r \text{ of donor to own offspring} \\ C \text{ loss to altruist} = r \text{ of donor to recipients offspring} \end{array}$$

Oiling. Rubbing behavior of birds serving to distribute oil from the oil gland at the base of the tail over the feathers; in particular rubbing the back of the head on the back.

Olfactory. referring or relating to the sense of smell. [HWS]

Omnivorous. Feeding on a wide variety of food both plant and animal.

On-the-dot sampling. A system of sampling in which the behavior is recorded at a specific time interval.

Ontogenesis. Individual development.

Ontogeny. The development of characters such as behavior over the life of the individual.

Oophagy. The eating of eggs; egg cannibalism.

Open-field test. An animal is placed in an open arena and its activity is measured. (HJB)

Open-loop behavior. Behavior that is performed without feedback control, characteristic of behaviors where speed or response time is crucial, such as escape responses.

Operant. (1) An adjective specifying a response or behavior which is identified by its consequences (as, for example, by its producing a specific reinforcing stimulus under a given set of conditions) and for which eliciting stimuli have not necessarily been determined (and which is therefore unpredictable with respect to its appearance in the presence of a set of stimuli until it has been brought under the control of discriminative stimuli by reinforcement in their presence). (2) An operant response. (V)

Operant behavior. The totality of operant responses in the behavioral repertoire of the animal. (V)

Operant conditioning. The experimental procedure of presenting the animal with a reinforcing stimulus immediately following the occurrence of a given response. Conditioning is said to occur if, and only if, the response then increases in rate of occurrence, magnitude, or relative frequency, or decreases in latency, as a consequence of this operation. (V)

Operational definition. A definition that is put into measurable, researchable terms. (HJB) A meaning that is restricted to observational or measurement or manipulation procedures. The term

was first used in physics, but it has also been applied in the study of behavior. Thus "behavioral tendency" might be defined operationally in terms of the level of stimulation necessary or sufficient to elicit the behavior, with no "surplus meaning" implied about unobservable internal state of processes. Strict operationalism would bar the use of hypothetical constructs. Behaviorists insisted on operational definitions of psychological terms, although they were not always consistent in their adherence to it. In ethology the replacing of the term "action-specific energy" with "specific action potential" was an example of operationalism. (IB)

Operational sex ratio. OSR. The ratio of receptive males to receptive females in a population at any one period; a measure of the intensity of competition among males for mates. [JA]

Operationism. The general point of view toward the data and concepts of natural science which holds that the concepts of a science are defined by the experimental operations involved in investigation and measurement. (V)

Operator. A region of DNA that interacts with a repressor protein to control the expression of an adjacent gene or group of genes. (S)

Operon. (1) A unit of linked cistrons, the expression of which is controlled by an operator (which is a genetic element that acts as a receiver of specific cytoplasmic signals in the form of repressor-substance molecules and controls an operon); a genetic unit of transcription of the DNA code. (2) A gene unit consisting of one or more genes that specify a polypeptide and an "operator" that regulates the transcription of the structural gene (the regulator and the coding genes are adjacent on the DNA molecule). (S)

Opportunistic species. Species specialized to exploit newly opened habitats. Such "weedy" species usually are able to disperse for long distances and to reproduce rapidly: i.e. they are r-selected. (W)

Opportunity cost. C. The gain from not performing an action; e.g. the opportunity cost for paternal care is reduced polygyny. (see Hamilton's Rule)

Optimality. An optimality model seeks to predict which particular tradeoffs between costs and benefits will give the maximum benefit to the individual under the circumstances. (JK)

Optimal outbreeding. Refers to the situation in which animals are not mating with close relatives but neither are they mating with totally unrelated individuals; there is an optimal degree of relatedness which maximizes reproductive success. (HJB)

Optimization theory. Optimality theory. In behavioral ecology, an approach to the question of whether and how organisms presented with alternative strategies for exploiting their environments select the option that maximizes benefits and minimizes costs. The theory has been directed mainly at optimal foraging patterns. (IB)

Optomotor response. A feedback system by which animals adjust their position with respect to a moving background. When one rotates a drum around an animal, the individual responds by turning its body in the opposite direction as though it is attempting to stabilize the image of the cylinder's stripes on its retinae.

Ordinal data. variables categorized into mutually exclusive groups arranged with reference to their magnitude [HWS]

Organism. Individual living thing. A multicellular organism is a harmonious integration of cells, tissues, organs, and systems. In certain animal groups, however, the degrees of dependence and independence of parts make it difficult to decide where the line should be drawn between individual organisms and assemblages. For example, the Portuguese man-of-war (*Physalia*) is regarded as a colony of coelenterate "persons," yet it looks and behaves so much as a unit that it is difficult to resist the impression that the whole is the individual organism. Sponges present a contrasting case of cells so loosely bound together physiologically that they might be considered collectives rather than individuals. In some insect societies the degrees of dependence among the members suggest analogy with the cells of a body: hence the concept of the super organism or supraorganism. (IB)

Organizational effect. The effect of certain hormones in shaping the development of the proximate mechanisms that underlie a behavioral ability. [JA]

Orientation. The perception of one's position in space. Primary orientation controls the body posture whereas secondary orientation controls the response to a stimulus from the environment.

Orientation flight. After leaving the nest the animal flies or moves around the area and learns the landmarks or other cues of its environment so that it can return to the home base.

Orogeny. The process of the formation of mountains. (WS)

Orthogenesis. The discredited theory that evolution is directed toward some ultimate goal.

Orthokinesis. Refers to kinesis orientation behavior in which the animal moves at different rates under different conditions. (V)

Orthologous gene. Duplicate corresponding genes at the same loci in different species.

Orthogenesis. Evolution continuously in one direction over a considerable period of time; commonly used with the implication that the direction is determined by a factor internal to the organism or at least not determined by natural selection [LBC]

Orthokinesis. A change in the rate of random movement of an organism in which the rate of location varies with the intensity of the stimulus. [LBC]

Orthoselection. Selection exerted upon a lineage in the same direction for a substantial segment of geological time. (SG)

Outbreeding. Refers to mating with non-relatives. (HJB)

Outgroup. An outgroup is a species or higher monophyletic taxon that is examined in the course of a phylogenetic study to determine which of two homologous characters may be inferred to as apomorphic, a derived character state based upon comparison with the ancestral state. [Wil]

Overcrowding. An excessively high spatial density of animals due to some abnormal environment. The consequences depend on its intensity and duration. [HWS]

Overdominance. The expression by two alleles in heterozygous condition of a phenotypic value for some characteristic that lies outside the range of the two corresponding homozygotes; a possible basis for heterosis, but not the only one. Higher fitness of a heterozygote than of homozygotes at that locus (heterozygous advantage) is often termed overdominance for fitness.

Overlearning. Continuation of learning trials beyond the stage necessary for required retention. [HWS]

Overshadowing. A phenomenon in which the reinforcing properties of a reinforcer are diminished by the concurrent presentation of some strong distracting stimulus. [HWS]

Ovigerous. Egg-bearing; used of a female that is carrying eggs as with some species of crabs.

Ovulation. Follicle rupture, egg release.

Oxidizing. A term pertaining to a process or environment in which a chemical element or ion is oxidized via the loss of electrons. (WS)

p. The frequency of an allele at one locus in a population. $p+q=1$

Pacing. (1) In contrast to cross gait where both legs on one side of the body are moved forward at the same time. This results in a swaying gait. Pacing is the usual form of locomotion in elephants, giraffes and some antelopes. (2) An entirely different meaning refers to walking back and forth repetitively.

Paedomorphosis. The retention of ancestral juvenile characters by later ontogenetic stages of descendants. (SG)

Pain. A cognitive response resulting from injury or disease. Cannot be defined in an objective manner. Pain may be instrumental in inducing fear responses. (DM)

Pair bond. Refers to the long-term attachment between a male and female. Requires individual recognition. Often accompanied by specific patterns of behavior that appear to strengthen the association. Mating and parental care usually occurs among the members of a pair.

Pair formation. The behavioral interaction of two future mates which leads to the formation of a pair bond.

Pairing territory. Pairing takes place at defended spot away from nest.

Paleoethology. Study of the behavior of extinct animals.

Paleontology. The study of extinct organisms. (M)

Paleozoic. Earliest era of the Phanerozoic Eon. (WS)

Palindrome. A self-complementary nucleic acid sequence, that is a sequence identical to its complementary strand; perfect palindromes (e.g. GAATTC) frequently occur at sites of recognition for restriction enzymes; less perfect palindromes (e.g. TACCTCTGGCGTGATA) frequently occur in binding sites for other proteins, such as repressors. (S)

Pangea. The supercontinent that is believed to have existed near the beginning of the Triassic. The precursor of Gondwana and Laurasia. (WS)

Pangenesis. Darwin's theory of heredity. Somatic cells contain particles that can be influenced by the environment and the activity of organs containing them. These particles can move to the sex cells and influence the course of heredity. (SG)

Panmixia (panmictic). Populations in which mating is random, i.e. in which there are no mating preferences. (mD)

Panting. A response to overheating in many ducks, corvids, birds of prey etc., characterized by fast breathing with the beak wide open. Canids and felids also pant which is a physiological and behavioral response for cooling. (H)

Paracentric inversion. An inversion in which both breaks occur on the same arm of the chromosome. (BC)

Parallel evolution. The evolution of similar characters separately in two or more lineages of common ancestry and on the basis of, or channeled by, characteristics of that ancestry. (DO)

Paralogous. Two or more gene loci, or their polypeptide products derived by duplication of an ancestral locus and occurring together in a haploid chromosome complement.

Paralogous gene. Duplicate loci within a species (arising from gene duplication).

Parapatric. Pertaining to populations or species, geographically in contact but not overlapping and rarely or never interbreeding. (M)

Parapatric speciation. A form of speciation between populations which are in contact with one another but not overlapping in their ranges (see area-effects speciation and clinal speciation).

Paraphyletic group. A group of taxa derived from a single ancestral taxon but one which does not contain all the descendants of the most recent common ancestor. [LBC]

Parasitism. (1) An interaction among members of different species in which the parasite exploits the host. (DM) (2) Any interaction in which an individual exploits another individual.

Parasocial. (1) Refers to an association, either permanent or temporary, between adult individuals of the same generation, usually sisters or brothers. (2) The parasocial route to sociality refers to a long-term cooperative association between sisters.

Parasympathetic nervous system. (See autonomic nervous system)

Parent-offspring conflict. An evolutionary or genetic conflict of interest between parents and their young.

Parental care. Care given by parents toward their offspring.

Parental effort. Energy or resources donated to offspring which do not take away from future reproduction, i.e. do not involve tradeoffs. (HJB) (contrast with parental investment)

Parental facilitation. Aid given by parents to their offspring that improves the ability of the latter to achieve breeding status. Parental facilitation is not extended parental care in the usual sense, since the normal types of parental care, such as feeding young, are not involved. (Brown 1987).

Parental investment. The risks taken by a parent and the time and energy it invests in an existing offspring that reduces its chances of producing additional offspring in the future. [JA]

Parental manipulation. "Parental manipulation of progeny refers to parents adjusting or manipulating their parental investment, particularly by reducing the reproduction (inclusive fitness) of certain progeny in the interests of increasing their own inclusive fitness via other offspring." (Brown 1987).

Parental preference. Preference of a parent to care for or associate with a particular offspring. [HWS]

Parsimony. Using the fewest number of character changes in the construction of a phylogeny. Phylogenticists use parsimony to tentatively accept for further study the cladistic hypothesis that best fits the data at hand, the one supported by the fewest homoplasies. [Wil]

Parthenogenesis. The development of an individual from an unfertilized gamete. (E)

Particulate inheritance. Mendel's theory that the genetic factors received from mother and father do not blend or fuse, but retain their integrity from generation to generation. (M)

Parturition. The process of giving birth. [HWS]

Paternal care. Care given by the father toward his offspring.

Paternity assurance or certainty. Refers to the probability that the offspring a male is helping to rear are his own. Specific adaptations evolve such as mate guarding to increase paternity certainty.

Pawing. A scooping leg movement, generally on the ground. [HWS]

Pecking. Making contact with an object or the body of another organism using the tip of the beak. [HWS]

Peck order. Social hierarchy in domestic birds. [HWS]

Pelagic. A term pertaining to the open ocean environment or to the organisms inhabiting that environment. (WS)

Penetrance. A measure of the proportion of individuals homozygous for a gene that show its phenotypic effect.

Peramorphosis. Development is accelerated or lengthened relative to the ancestor so that maturity occurs at an older developmental stage.

Perception. (1) A generic term for the complex sensory control of behavior. (2) A hypothetical internal event of unspecified nature controlled largely by external stimulation (but sometimes also by state variables such as habit and drive). (V)

Pericentric inversion. An inversion in which the breaks occur on opposite sides of the centromere. (BC)

Peripatric. Of populations, situated peripheral to most of the populations of a species. (F)

Peripatric speciation. Speciation by evolution of isolating mechanisms in peripatric populations. (F)

Peripheral male. see satellite male.

Permian. A geological period of the paleozoic 290-245 my ago.

Persistence. Refers to situations in which animals lock on to one activity and are resistant to changing to another action.

Personal space. see individual distance.

Phanerozoic. The more recent eon of earth history composed of the Paleozoic, Mesozoic and Cenozoic eras. (WS)

Phenetic. Pertaining to phenotypic similarity; used especially to describe taxonomic relationships based on phenotypic similarity in contrast to phyletic relationships based on recency of common ancestor. (E)

Phenocopy. A modification of the phenotype owing to special environmental conditions which resembles a change of the phenotype known to be caused by a mutation. (M)

Phenology. Study of the temporal aspects of recurrent natural phenomena and their relation to weather and climate [LBC]

Phenogram. A phylogenetic tree that emphasizes similarity (see cladogram).

Phenotype. Any character or set of characters of an organism; the morphological, physiological, biochemical, behavioral, and other properties of an organism, manifested throughout its life, that develop through action of genes and environment; or any subset of such properties, especially those affected by a particular allele or other portion of the genotype. (F)

Phenology. The timing of recurring natural phenomena, and its study. In ethological contexts phenology refers mainly to the timing of breeding seasons, especially in relation to cyclic changes in weather conditions. (IB) The timing of natural events.

Phenotype. Any character or set of characters of an organism; the morphological, physiological, biochemical, behavioral, and other properties of an organism, manifested throughout its life, that develop through action of genes and environment; or any subset of such properties, especially those affected by a particular allele or other portion of the genotype. (F)

Phenotype matching. A means of kin recognition by which an animal uses its own characteristics or those of kin with which it has associated to distinguish relatives from nonrelatives. It enables an animal to tell a relative that it has not encountered before from a nonrelated stranger. In the case of sweat bees (*Lasioglossum zephyrum*) it has been shown that a female guarding a nest will admit strangers as long as they are of the same family as the bees with which the female was raised, even if these were not her own siblings. (IB) See Kin recognition. A proximate mechanism of kin discrimination in which an individual's behavior toward another is based on how similar they are in appearance, odor, or some other phenotypic trait. [JA]

Phenotypic plasticity. The ability to develop different phenotypes under different conditions. see norm of reaction.

Peripheral. Of the surface of the body.

Pheromone. A chemical substance, usually a glandular secretion, that is used in communication within a species. One individual releases the material as a signal and another responds after detecting it. (W) A chemical substance, usually a glandular secretion, that is used in communication within a species. One individual releases the material as a signal and another responds after detecting it. (W) Specific chemicals that function in intraspecific communication. Also sometimes ectohormone or social hormone. Pheromones are hormone-like substances produced by glands that, in contrast to true endocrine glands, secrete to the exterior of the body. They thus affect not the individuals producing them but other individuals of the same species. (IB)

Philopatry. The tendency to return to the natal site. The tendency of an individual to return to (or stay in) and breed in its home area (birthplace or other adopted locality). (M)

Phobia. An excessive, persistent and apparently unsubstantiated fear specific to a given stimulus, situation or circumstance. [HWS]

Phoretic behavior. Phoresy. Behavior of animals using other animals generally of larger size as a temporary means of transport. Also called hitchhiking.

Photoperiod. Daylength.

Photoreceptor. Receptors sensitive to light.

Phototaxis. An orientation response with respect to light.

Phyletic evolution. Change that occurs sequentially in a single line of descent (cf. anagenesis). (D)

Phyletic Gradualism. (see phyletic evolution, contrast with punctuated equilibrium)

Phylogenetic Inertia. Those underlying genetic mechanisms and preadaptations that determine the direction and rate of evolutionary change.

Phylogeny. Phylogenetic. A genealogy that reflects the evolutionary relationships among a number of species, genera, or other clusters of organisms.

Pica. Abnormal appetite for unusual and often inappropriate food, e.g. dirt, hair, feces. [HWS]

Piloerection. In many mammals the erection of the fur or hair in connection with threat possibly as a means of effecting a more impressive appearance. (H) Also associated with thermoregulation.

Pilot fish. Fish that accompany sharks, mantas and serve as cleaners for them or they may just feed on wasted food. They are often seen swimming near the dorsal fin of sharks.

Piloting. Orientation by the use of local landmarks. (HJB)

Pipping. The first cracking of the egg shell by the hatching chick. [HWS]

Plasmagones. Hereditary factors located in the cytoplasm; a cytoplasmic factor. (D)

Plasmid. Extrachromosomal, autonomously replicating, circular DNA segment. (S)

Plasticity. Ability to develop different phenotypes under different environmental conditions.

Plates. The earth's lithosphere or outer crust is broken up into a number of plates separated by faults and trenches.

Plate tectonics. The process of chiefly horizontal movements of the upper layer of the earth, including the continents and ocean crust, as a result of heat flow from the interior and seafloor spreading. (AV)

Play bow. An action pattern of canids and felids in which the animal suddenly lowers the front part of the body and spreads the legs apart. This has the effect of serving as a display for initiating play. (HJB)

Play. Behavior that lacks a specific serious context and where the regular sequence of appetitive and instinctive movements is absent; play behavior usually occurs at a lower intensity and is directed toward inappropriate objects but often is similar in appearance to the normal actions.

Play signal. A facial expression or body posture that signifies readiness to play.

Pleiotropy. The property of a gene whereby it affects two or more characters.

Pleistocene. The major epoch of the Quaternary period, beginning about 1 million years ago and ending about 10,000 years ago.

Pleistocene refugia. Favorable areas south of the border of the glacial ice, in which certain species survived the extreme environmental conditions of the Pleistocene. (M)

Pleometrosis. The founding of a colony of social organisms by more than one original female.

Plesiomorphy. An ancestral character state determined by outgroup comparison. [Wil]

Plural breeding. A social system in which two or more females (monogamous or not) breed in the same communal social unit. The term does not apply to colonial species unless communal units exist within the colony. See singular breeding. (Brown 1987).

Point mutation. A mutation within a gene, such as the changes in a codon, addition or loss of a base, etc. (D)

Poisson distribution. A mathematical distribution used to describe or test for a random distribution or process.

Polarity. Of a character, whether postulated homologies are ancestral or derived.

Polyandry. Refers to a mating system in which females have more than one mate during a breeding season whereas the males normally have only one. A mating system characterized by a behavioral bond between one breeding female and two or more males breeding with her.

Polyethism. Behavioral polymorphism, e.g. age polyethism is the regular changing of roles by the individuals of an insect colony as they age.

Polygamy. Polygyny.

Polygenic character. A trait, the variation in which is based wholly or in part on allelic variation at several or many loci. (F)

Polygeny. The capacity of several genes to influence the development of a trait. [JA]

Polygynandry. A mating system characterized by behavioral bonds between two or more breeding females and two or more males breeding with them.

Polygyny. (1) Refers to a mating system in which males have more than one mate during a breeding season whereas females normally have only one. (2) In social insects refers to multiple queens. Female defense polygyny occurs when polygynous males directly defend their mates from other males; lek polygyny occurs when males use displays to attract several females to them at small, resourceless display sites; resource defense polygyny when males monopolize resources that receptive females use; scramble competition polygyny when males are nonterritorial and seek scattered receptive females. [JA]

Polymerase. Enzymes that catalyze the assembly of nucleotides into RNA and of deoxynucleotides into DNA. (S)

Polymerization. The formation of large organic molecules from many like subunits.

Polymorphism. The existence in a population of two or more alleles at a locus. Also, the existence in a population of two or more discrete alternative phenotypes.

Polyphagous. Feeding on many kinds of food; usually used to describe insects that feed on many plants. (F)

Polyphyletic. A taxonomic grouping that excludes the stem ancestor and excludes some of the descendants. Species are grouped based on convergent similarities. [Wil]

Polyploidy. The condition in which the number of chromosome sets in a cell is a higher multiple of the haploid number than two (which is diploidy). (see allopolyploidy, autopolyploidy). (mD)

Polytocous. referring to animals that typically deliver several offspring at each parturition. [HWS]

Polytypy. Geographic variation in which each of one or more distinctive forms is found in each of several separate localities, between which other forms are distributed. (F)

Polytypic species. A species consisting of two or more subspecies. (D)

Polytypy. The existence of named geographic races or subspecies within a species. (F)

Population. A group of conspecific organisms that occupy a more or less well-defined geographic area and exhibit reproductive continuity from one generation to the next; it is generally presumed that ecological and reproductive interactions are more frequent among the individuals of a population than between them and the members of other populations of the same species. (F)

Population fitness. W. The average of fitness of a set of genotypes belonging to the same population. (WB)

Position effect. A difference in the phenotypic expression of a gene associated with a change in its location on the chromosomes. (F)

Postcopulatory behavior. Display or action occurring immediately after copulation.

Post displacement. Paedomorphosis resulting from a later starting point to development.

Post-mating Reproductive Isolating Mechanism. A mechanism that prevents the formation of fully fertile hybrids, including zygote mortality, hybrid inviability, hybrid sterility and hybrid breakdown.

Postsynaptic. Refers to the site in a synapse at which information arrives.

Postzygotic. After an egg has been fertilized; usually applied to isolating mechanisms that exercise their influence after fertilization has occurred. (D)

Pounce. A term applied to the stiff-legged jumps of canids and felids on mice and other small prey animals. (H)

Practice. The observed occurrence of a specified part of behavior one or more times. The greater the number of occurrences, the greater the amount of practice.

Pragmatics. In communication the study of the relations of signals to their effects. The "meaning" of communication.

Praise. A type of positive reinforcer given for a specific behavior. [BB]

Preadaptation. The coincidental possession of traits favorable to a new environment before that environment is actually occupied, as air-breathing apparatus possessed by some aquatic animals prior to their becoming terrestrial. (D) Does not imply adaptation for future use. Also called exaptation by SG.

Precambrian. The earliest eon of earth history, composed of arch eon and the proterozoic eras. (WS)

Precocial. Young are born at an advanced state of development, which can feed independently and locomote.

Predation. An interaction among members of different species in which one, the predator, gains by capturing and consuming the prey. (DM)

Predatory behavior. The behavior by means of which an animal of one species, the predator, captures, kills and eats a member of another species, the prey. (DM)

Predisplacement. Peramorphosis resulting from an earlier starting point to development.

Pre-mating Reproductive Isolating Mechanism. A mechanism that prevents interbreeding before a zygote is formed, including behavior, mate choice, habitat selection, seasonal differences.

Preening. Behavior serving to care for the feathers.

Preference. Choice of a certain alternative over another alternative. This term generally is used in reference to a preference test. [HWS]

Preparturient behavior. Behavioral actions indicative of impending parturition. [HWS]

Presentation of nesting material. This behavior is found in many birds as an appeasement gesture when the mate arrives to take over incubation.

Presynaptic. Refers to the site in a synapse from which the transmitter is released or from which information leaves one cell and enters the next.

Prey-catching behavior. Refers to actions of predatory behavior which lead the animal towards the seizing of prey.

Prezygotic. Active before the egg has become fertilized; usually applied to isolating mechanisms that interfere with fertilization of the egg. (D)

Primitive. (a) A character that is present in some or all members of a taxon and that was inherited from the most recent common ancestor of that taxon. (b) An organism which has a set of characters which are, on average, primitive.

Prisoner's Dilemma Game. A two-player game in which the players have the choice between cooperating or defecting. The essence of the game is in the payoff matrix where the payoff from cooperating (reward for mutual cooperation) is less than the gain from defecting (defecting when the other player as cooperated), but mutual cooperation does better than mutual defection. This is a symmetrical game between two players that is defined by the following payoff matrix. $T > R > P > S$

		9;	
		Player B	
9; cooperate S = 0 Player A P = 1	cooperate	defect	
		cooperate	R = 3
	defect	cooperate	reward for mutual coop
		defect	sucker's payoff T = 5
temptation to defect		punishment for mutual defection	

Probability of response. (1) Relative frequency of response, determined over a number of trials, in situations where any one of several alternative responses may be given. (2) A synonym for strength of conditioning, preferentially employed by those who use rates of response as an experimental dependent variable. (V)

Proceptive behavior. Sexual invitation by female mammals to solicit copulation from males.

Process. (1) Changes in response-strength that are a function of experimental manipulation. (2) A term applied to hypothetical and unspecified sets of events occurring with the passage of time that are inferred from data showing differences in the magnitude of one or more dependent variables that are functions of time or functions of some variable that is in turn a function of time. (3) A progressive series of changes. (V)

Progenesis. A decrease during evolution of the duration of ontogenetic development, resulting in retention of juvenile features in the sexually mature adult. See **Paedomorphosis**. (F) Deceleration specifically resulting from an earlier endpoint to development.

Prokaryote. Cells without a well-defined nucleus, plastids, Golgi bodies, or mitochondria; blue-green algae and bacteria. (E)

Programmed learning. Refers to the observation that in many species the animals have very specific categories of information that they acquire rather than a generalized knowledge of the environment. (HJB)

Programmed rule. A decision rule that is programmed by natural selection. May or may not involve thought. (HJB)

Progressive provisioning. Repeated feeding of larvae during development.

Promiscuity. (1) Refers to a mating system in which both males and females have more than one mate during a breeding season. (2) A mating system in which there are no pair bonds.

Promoter. A DNA sequence at which RNA polymerase binds and then initiates transcription. (S)

Proprioceptors. Receptors responding to stimuli from the body. They consist of free nerve endings terminating in cuticle or muscle which transmit information about the relative position of different parts of the body.

Protandry. (1) In a hermaphroditic animal or plant, protandry refers to being male first and female second. (2) In a species with two sexes, such as an insect, protandry refers to the males emerging before the females during the nesting season.

Protean behavior. A diversionary tactic or behavior named after Proteus the Greek sea god who escaped his pursuers by continually changing his form. May involve unpredictable changes of direction during flight or other evasive behaviors. (DM)

Protein. A class of compounds of high molecular weight formed by the combination of amino acids with or without other molecules. (E)

Proterozoic. An era of earth history in the precambrian. (WS)

Protobiont Coacervate droplets that selectively absorb and concentrate small molecules from the environment and change and incorporate them once inside. (E)

Protogyny. (1) In a hermaphroditic animal or plant, protogyny refers to being female first and male second. (2) In a species with two sexes, such as an insect, protogyny refers to the females emerging before the males during the nesting season.

Provincialized. Refers to a biota that is becoming increasingly isolated due to the movement of land masses which fosters the independent evolution of regional biotas.

Proximate determinants of behavior. The immediate causal factors (developmental, hormonal, sensory) influencing the behavior of the individual. (see ultimate determinants)

Prudent predator. A hypothesis to explain the fact that predators prefer to catch young, old or weak prey from among those available. Under this hypothesis the explanation is that the predator shows these preferences because if it took the breeding females it would reduce the size of the prey population on which it depends, an obviously group selectionist explanation.

Punctuated equilibria. Most major evolutionary transitions and changes are temporally associated with speciation (SS). There are periods of rapid speciation and rapid evolution with intervening periods of very slow rates of evolution.

Punctuated evolution. See punctuated equilibria

Psammophilous. Thriving in sandy habitats.

Pseudocopulation. A form of copulation that lacks the function of fertilization. It has been described in fishes, birds, and mammals. In mammals it may consist of mounting with or without intromission. Pseudocopulation can take place between a male and a female, two males, or two females. In the heterosexual situation it probably serves as support for the pair bond and represents an example of sexual behavior emancipated from an immediate reproductive connection. Pseudocopulation between same-sex animals is difficult to interpret. Its biological significance probably varies with different species and relationships. In primates, where it is especially common, it can be viewed as a demonstration of higher status within a rank order. However, this explanation will not do for all cases, for in many species the individual mounted may be the dominant one. In all-male groups pseudocopulation possibly serves to maintain reproductive readiness. As a rule pseudocopulation is most in evidence during occasions of general excitement and in conflict situations. It may also occur during play behavior. (IB)

Pseudofemale behavior. Behavior by males that appears to be similar to that of females.

Pseudogene. A sequence that looks like a gene but does not function as one; it appears to have no phenotype and could be the vestigial remains of a gene. (S)

Pseudomale behavior. Behavior by females that appears to be similar to that of males of the same species.

Pseudopregnancy. A condition that can occur in female mammals when mating fails to cause conception. The stimulation of copulation gives rise to the same hormonal changes that result from pregnancy and hence the other physiological changes that go with that condition, such as cessation of ovarian cycling (see estrus). (IB)

Pseudoextinction. The disappearance of a lineage from the fossil record due to its evolution into a new form rather than to its termination. (AV)

Pseudospecies. A species that is derived through anagenic change, i.e., over time there has been sufficient change for it to be called a species by taxonomists. (syn. chronospecies).

Psychology. The study of mental life and behavior. (IB)

Punctuated equilibrium. A term introduced by Eldredge and Gould (1972) to characterize a theory about rates of evolution. It opposes a more conventional view, stemming from Darwin, according to which microevolution, such as occurs in populations, and macroevolution, such as causes the origin of species, are on a continuum, with the same gradual sifting of heritable variations by selection applying throughout. This view is described as phyletic gradualism. According to the theory of punctuated equilibria, there is a radical difference between microevolution and macroevolution. It holds that species are established by sudden bursts of change, in terms of the geological time scale, and then settle into a relatively static history until they become extinct. Instead of individual or genic selection governing evolution within a species, the origin and extinction of species that constitute macroevolution are thought to involve some

form of species selection. These ideas are highly controversial as regards both the proposed pattern and the proposed process of evolutionary change. (IB)

Punishment. The procedure of following the occurrence of a conditioned response with an aversive stimulus.

Pupillary response. The expansion and contraction of the pupils serve to regulate the amount of light entering the eye. This mechanism is widespread among mammals.

Pure strategy. When all individuals of the population have the same strategy. (see ESS)

Puzzle box. A general term used for any boxlike apparatus used to study learning, memory or other mental abilities. [BB]

q. The frequency of an allele in a population: $p+q=1$

Quantal Speciation. Speciation in allopatry which is rapid due to founder and bottleneck effects (see peripatric speciation).

Quantitative ethology. A term sometimes used for the quantitative recording and subsequent analysis of behavior. It provides an important basis for the compilation of an ethogram. The quantitative treatment of characteristics that allow recognition of bonding within a social group is referred to as sociometry. (IB)

Quantitative trait. A trait that varies continuously.

Quantum evolution. Very rapid evolutionary change, often assumed to be involved in the production of new higher taxa. (D)

Quasisocial. A social group in which members of the same generation use the same nest and cooperate in brood care but all individuals breed (social insects).

Queen. The reproductively dominant individual in a eusocial colony.

Queenright. A colony with a functional queen.

r. (1) The intrinsic rate of increase; the fraction by which a population increases in size in each unit of time. (WB) (2) r Coefficient of genetic relationships; relatedness. see Hamilton's Rule

r-selection. Selection that favors organisms producing large numbers of offspring each with a relatively low probability of survival; often associated with low competitive ability, short lifespan, rapid development, early reproduction and good dispersal ability. (see K-selection). (BR)

Rabbit-fox principle. The notion that in arms races (such as between predator and prey) there may be unequal selective pressures on the two parties (in this case the rabbit is running for its life whereas the fox is running for its dinner which means that selection is stronger on the rabbit) and thus may win the arms race.

Race. A poorly defined term for a set of populations occupying a particular region which differ in one or more characteristics from other populations; sometimes referring to local variations or polymorphisms within a population and sometimes equivalent to a subspecies. (F)

Random fixation. The loss of an allele (and fixation of the other allele) in a population owing to accidents of sampling (genetic drift). (mM)

Rank mimicry. Imitation by lower-ranking individuals of the behavioral characteristics of higher-ranking individuals (see Rank Order). In primates it may play a role independent of rank (see Basic Rank). An acoustic example of rank mimicry has been noted in some birds, in which young males selectively learn the songs of higher-ranking males. So far this tendency has been established only in polygynous and promiscuous species, in which it probably aids the mimicking males in their efforts to attract females. (IB)

Rank order. Social hierarchy, dominance hierarchy, peck order. Ordered distribution of "rights and obligations"-precedence and subordination-within a group of animals living together. The stronger or more experienced individuals stand higher in the order and consequently enjoy certain privileges, such as first access to resources. (IB)

Rape. Forced copulation.

Rare male effect. The situation in which females prefer the male that is different from the others, i.e. female preference for a phenotype depends on its frequency in the population (males are preferred when rare). This is a frequency-dependent effect. When the mating success of a male depends on the frequency of his phenotype in the population.

Rare enemy effect. The intensity of selection depends on the number of predators, and if predation is not common, selection may not favor a phenotype that reduces predation.

Rassenkreis. A species composed of geographic races or subspecies. (F) (as distinct from Arten Kreis).

Rate of evolution. Rate at which a population adapts to a change in the environment.

Rate of response. The number of responses occurring in unit time. (V)

Reaction chain. (1) A sequence of responses or reactions which are each dependent on the previous one. (H) (2) A pre-programmed sequence of responses or reactions especially among behaviors occurring in a social context. (3) Many single responses follow each other in a certain sequence or chain which seldom varies in order.

Reaction norm. The normal pattern of reactions of an animal to directional stimuli in which the form of the movement remains independent of the respective stimulus.

Reading. One-way linear process by which nucleotide sequences are decoded, for example, by protein-synthesizing systems.

Reafference principle. A concept developed by von Holst and Mittlestadet to explain the regulation and interaction of internal signals and sensory signals in directing and in coordinating bodily movements. In general signals from the sensory organs running to the processing unit are termed afferents and all impulses that run centrifugally and set the motor units in action are called efferent. The reafference principle requires storage of an efference copy of each spontaneous activation of a motor unit by the processing unit. This efferent copy fixes the reference value of parameters required to execute the movement and this information guides the response until the reafference from the motor unit to the processing unit indicates an accordance with the reference value or set point. If during the movement an unexpected disturbance is encountered, the efference

copy is reexamined in relation to the new information and the executing maneuvers are corrected until the goal is reached. All such additional inputs from the periphery are called exafferents. (H)

Recapitulation. The repetition of ancestral adult stages in embryonic or juvenile stages of descendants. (SG) The ontogenetic passage of an organism's features through stages that resemble the adult features of its phylogenetic ancestors. (F)

Receptive field. For any unit in a sensory system, the area from which it receives input that changes its activity. The effects can be either an increase in the activity of the unit (positive input) or a decrease (negative input). For example, most of the axons (neuron fibers) in the optic nerves of a cat have receptive fields at specific spots on the retina; these consist of an excitatory center ("on" center) with an encircling inhibitory ring ("off" surround). This arrangement is a consequence of the fact that a retinal receptor cell excites the optic nerve neurons immediately underlying it but inhibits those with which it connects (via intermediate cells) in the surrounding area. This process of lateral inhibition has the effect of enhancing contrast in perception of the edges of retinal images. Units have been discovered in the visual systems of frogs that have receptive fields tuned to the visual patterns presented by flying insects. These "bug detectors" provide the kind of stimulus filtering that releasing mechanisms were postulated to provide. (IB)

Receptor. Sensory site.

Recessive. Of an allele, the phenotypic trait is not revealed when heterozygous, only when homozygous.

Reciprocal altruism. Altruistic behavior between nonrelated individuals, conducted according to the rule that an individual helped on one occasion of need will likewise aid the other when the need for help is reversed. For this behavior to be selected over a purely "selfish" strategy, the benefit of getting help when it is needed, compared to the cost of giving help when it is called for, must be greater, in terms of breeding success, than that of the selfish alternative (see Fitness). Because an altruistic system can be exploited by individuals that accept help but never return it, who enjoy its benefits without incurring its costs, it is unlikely to evolve unless the "spongers" can be combated in some way. The conditions would include a group small enough that the same individuals meet frequently and recognize one another individually (see Individual). (IB)

Reciprocation, Reciprocity. "The state or condition of being reciprocal; a state or relationship in which there is mutual action, influence, giving and taking, correspondence, etc., between two parties or things" (OED). As used by Trivers (1971), who introduced the words to sociobiology, an exchange of favors is implied in which (a) the donor gives up or risks little but benefits the recipient more, in terms of inclusive fitness, and (b) the donor monitors the recipient to penalize failure to return favors by cessation of donor aid-giving to the "cheater." In the best known paper on the subject (Axelrod and Hamilton, 1981) reciprocation was associated most prominently with the Tit-for-tat strategy. In both of these influential papers reciprocity is associated with (a) a mutualistic relationship between reciprocators, (b) some kind of score-keeping used as a hedge against nonreciprocators. (Brown 1987).

Recognition. Retentive discrimination. The ability to differentiate between two categories of stimuli, but as properties of objects, places, or individuals rather than mere sensory discrimination (see Perception). In most cases recognition is a result of learning (as in individual recognition), but there are exceptions, such as species recognition. (IB)

Recombination. The formation of new combinations of genetic material by crossing-over during synapsis in meiosis. (mD)

Recruitment behavior. Behavior of worker social insects that attracts other individuals of the colony to a new food source, nest site or intruder in the nest.

Redirected behavior. Behavior directed at an inappropriate or substitute stimulus object or individual. (H) Any response elicited by a stimulus and, ordinarily, topographically directed toward that stimulus, which, in the presence of a drive-conflict, is topographically directed at a part of the environment that otherwise would not elicit it. (V)

Red Queen hypothesis. The idea that animals are in a continual evolutionary arms race with other members of their species and with other species and that they are never able to get ahead because of the coevolutionary response.

Reducing. A term pertaining to a process or environment in which a chemical element or ion is reduced via the gain of electron. (opposite of oxidizing). (WS)

Reductionism. The belief that complex phenomena can be entirely explained by reducing them to the smallest possible component parts and explaining these. (M)

Reductionism. Explanation of the molar in terms of the molecular; accounting for surface appearances by showing them to be consequences of an underlying structure or process on a more fundamental level. In behavior reductionism usually takes the form of showing how behavior is consequent on physiological mechanisms, which in turn can be understood in terms of their physics and chemistry. Reductionism is typically atomistic and deterministic. (IB)

Redundancy. In information theory redundancy exists when more signs are used to encode a message than would be sufficient to do so. It is deliberately included by the communications engineer when noise is likely to disturb signals in transmission. Redundancy is measured as the ratio of the difference between the most efficient coding and the observed coding to the most efficient coding. In a language such as English, redundancy enables us to read a text full of typographical errors: differences in the probabilities of letter sequences and of word combinations, syntactic constraint, and semantic connection combine to provide clues to what the words are supposed to be in most of the garbled cases. Most animal communication is repetitive and structured in ways that make it highly redundant. The genetic code is redundant in that many of the amino acids to which it refers are represented by more than one triplet sequence of bases. (IB)

Reflex. (1) An involuntary response of an organism to a stimulus in which the response proceeds in a clearly prescribed fashion or reflex arc. (2) Any S-R correlation, whatever its history or probability of occurrence. (3) A S-R correlation which is observable in all members of a species under a given set of conditions in which there have been experimental manipulations calculated to prevent learning. This is often further qualified as cases where change in strength are negligible with respect to drive-inducing operations. (V)

Reflex arc. Information comes into the animal through a specific receptor organ which responds to the stimulus, the information travels down an afferent pathway to the ganglion cells of the CNS; the efferent nerves carry the impulse to the effector organ which produces the appropriate response. (V)

Reflex sensitization. If, after repeated elicitation by its stimulus, a reflex response is then given in response to a previously neutral or much less effective stimulus with which the reflex stimulus has not been paired, reflex sensitization is said to have occurred. (V)

Refugia. Areas in which a species was confined during a period in its evolution and from which it later expands its range.

Regression. (1) Statistics: (2) geology: the lowering of sea levels so that the oceans do not cover the continents falling back below the continental shelf. (see transgression)

Regulatory gene. (1) The DNA transmitter of specific cytoplasmic signals in the form of repressor-substance molecules. (E) (2) A gene whose product is involved in the regulation of another gene, such as a repressor gene. (S) (3) A gene that controls development by regulating the turning on and off of structural genes that manufacture proteins. (SG)

Regulatory sequence. A DNA sequence involved in regulating the expression of the gene (e.g. promoters and operators). (S)

Reinforcement. (1) The operation of presenting to the animal in operant conditioning, after it has made a response (and therefore contingent on its occurrence), a reinforcing stimulus or of withdrawing a negative reinforcing stimulus. (2) In classical conditioning, the operation of presenting, contiguously in time, a conditioned stimulus and an unconditioned stimulus. (V)

Reinforcement/primary. The use in reinforcement of a stimulus that is a reinforcing stimulus to any animal of a given species without special training. (V)

Reinforcement/secondary (or conditioned). When a stimulus, initially ineffective, becomes a reinforcing stimulus after being presented to an animal contiguously in time with a reinforcing stimulus, it is termed a secondary or conditioned reinforcing stimulus, and the operation of presenting it is termed secondary reinforcement. (V)

Reinforcing stimulus. (1) In operant conditioning a reinforcing stimulus occurs if it can be shown that the animal alters some measure of its response when presented with an environmental event that is contingent upon that response. (2) In classical conditioning, the unconditioned stimulus. (3) Loosely, but almost universally, a positive reinforcing stimulus. Negative reinforcing stimulus is reinforcing stimulus that, if it is terminated following a response, increases the strength of response. If such stimuli are administered following the occurrence of a response, its rate or magnitude usually diminishes. Positive reinforcing stimulus is a reinforcing stimulus that, if applied following a response, increases the strength of that response. A primary reinforcing stimulus is any stimulus that is effective as a reinforcing stimulus for all the known members of a strain or of a species at the beginning of an experiment. A secondary (or conditioned) reinforcing stimulus refers to a stimulus which when presented stimulus has been presented to an animal in spatial and temporal contiguity with a reinforcing stimulus one or more times, if, and only if, it then acts as a reinforcing stimulus itself, it is termed a secondary reinforcing stimulus. (V)

Reinforcement/schedules of. Plans or procedures whereby the experimenter determines which ones of a series of responses will be reinforced. There are many possible schedules, which may yield quite different results. The most common ones are: (a) continuous (or regular) reinforcement--the experimental procedure of reinforcing a response each time it occurs. (b) Intermittent (or partial) reinforcement--any one of several procedures in accordance with which a response is reinforced only on some of its occurrences. (c) Fixed-interval (periodic) reinforcement--a schedule of intermittent reinforcement in which reinforcements are delivered according to a fixed and regular time schedule. (d) Variable-interval (a periodic or random) reinforcement--a schedule of intermittent reinforcement in which reinforcements are delivered according to a predetermined but irregular time schedule. (e) Fixed-ratio reinforcement--a schedule of intermittent reinforcement in which every nth instance of the operant response is reinforced. (f) Variable-ratio reinforcement--a schedule of intermittent reinforcement in which, on the average, every nth instance of an operant response is reinforced. (g) Multiple schedule--a schedule of intermittent reinforcement in which reinforcements by the same reinforcing stimulus are programmed according to two or more schedules in alternation. In multiple schedules, one of the component schedules is followed through an interval during which a discriminative stimulus is

presented to the animal. At the end of this interval, the first schedule is followed directly by a different schedule, presented in association with a different discriminative stimulus; this second stimulus is then used for a period of time; and so on. (h) Tandem schedule--a schedule of intermittent reinforcement in which single reinforcements are delivered according to two schedules acting in succession. (V)

Relatedness. r Coefficient of genetic relationships between two animals is the probability that a gene will be shared by the two animals by kinship. (F)

Releaser. (1) In ethology body markings and postures or behavior patterns which are adaptations for communication. (H) (2) Releaser is used as a synonym for sign stimulus. (3) A sign stimulus produced by the physical structure or behavior of an animal that releases some particular species-specific response or responses of a conspecific. (V)

Releasing mechanism (RM). Same as IRM except that it may refer either to a mechanism originating through ontogeny or phylogeny. (H)

Relict. Evolutionary vestige.

Reproductive dominance. Refers to any situation in which one female inhibits another female from reproducing either temporarily or permanently.

Reproductive isolation. Prevention of mating between one population and another, or between one species and its relatives. (D)

Reproductive success. The number of an individual's offspring that survive and reproduce. (W)

Reproductive value (1) v_x . Of an individual of a specific age, its likely contribution to the growth of the population. (F) (2) The relative number of female offspring that will be produced by each female that survives to age x . (WB) (3) The expectation of success over an individual's life span.

Repulsion. Of a gamete or chromosome, bearing at two or more loci alleles that have been designated to be unlike in some way. (F)

Response (or reaction) threshold. In theories that conceptualize as a state variable all the independent variables governing a response, the minimal value of the state variable that will evoke a response. (V)

Response equivalence, response generalization. (1) A term applied to the observation that two or more instances of the same response may not be alike topographically. (2) A term applied to the observation that when instances of two or more responses have been reinforced in the same situation they will then appear interchangeably. (V)

Resource-holding potential (RHP). An index of competitive ability. The term was introduced by Parker (1974) in reference to variation among males in their ability to obtain and defend possession of resources such as territory or a harem. Good predictors of resource-holding potential are size, physical strength, quality of an animal's advertisement display, and "badges of status." Thus a bigger animal can usually defeat a smaller one in a fight. Display features are often correlated with size and hence with RHP. Thus the deeper a toad's croak the bigger he is, because size determined how deep a note he can produce. Similarly a red deer stag's roaring tempo is indicative of his size and age and hence his RHP. RHP plays a role in both forms of sexual selection: intrasexual competition it may affect whether a contender will press a challenge; in intersexual competition it may be a factor in mate choice. (IB)

Resting. A behavioral state characterized by cessation or reduction of movement and lowered expenditure of bodily energy to avoid or recover from exhaustion. [HWS]

Resting potential. The difference in potential between the inside and outside of a cell when no stimulation has occurred.

Restriction enzyme. An enzyme that cuts double-stranded DNA at specific short nucleotide sequences. (F)

Retardation. A slowing down of development in ontogeny so that a feature appears later in the ontogeny of a descendant than it did in an ancestor. (SG)

Reticulate evolution. Union of different lineages of a clade by hybridization. (F)

Retrieving. Carrying back. (e.g. recovery of young). In animal behavior study retrieving most often refers to the recovery of young by rodent mothers: if pups are outside the nest the mother picks them up one by one in her mouth and carries them back into the nest. (IB)

Retrojektion. A German term for which there is no precise English equivalent, sometimes used to refer to an animal's using its own body, or parts of it, as a substitute object. Especially common are the sucking movements of young mammals: deprived of access to a mother's nipples, as when hand reared, such young suck on paws or fingers or other parts of their bodies. In social isolation experiments young primates often develop the habit of hugging their own bodies with their arms, thus using themselves as substitutes for the mother's body. (IB)

Reward. A colloquial term for a reinforcing stimulus. (V)

Rheotaxis. A directed response of a motile organism to a water or air current.

Rhythms. Regularly recurring patterns of behavior. Circannual rhythms are those occurring in phase with the tides. Lunar rhythms are those occurring in phase with the moon. Circadian rhythms are those associated with the day-night cycle. (DM)

Ribonucleic acid (RNA). Giant molecules of various types, some of which, in most organisms, copy the genetic code from the DNA and carry it to the sites of protein synthesis (messenger RNA) and some aid in the organization of the synthesis (transfer RNA). (E)

Ribosome. Granules associated with the boundary of the endoplasmic reticulum; the presumptive sites of protein synthesis. (E)

Risk. The chance of incurring a loss in reproductive success.

Risk-sensitive or risk-averse behavior. Behavior in which options are chosen with respect to the variance in the reward or punishment. The demonstration of risk sensitivity requires that basis for choice is not the option with the highest mean. This is done by making the means of the options equal and the variances unequal or by coupling the desired and chosen variance with the undesired mean. (Brown 1987).

Ritualization. (1) The term is used generally to refer to the modification of a behavioral pattern to serve a communicative function. Ritualization is usually associated with an action becoming more stereotyped, less variable between conspecifics and of a typical intensity. (V) (2) An evolutionary process by which behavior patterns become modified into displays. (DM) (3) The evolutionary

modification of a behavior pattern that turns it into a signal used in communication or improves its efficiency as a signal. (W)

Ritualized fight. Innate fighting pattern which is directed against conspecifics and which is stereotyped and appears to proceed according to set rules and does not normally result in damage despite the fact that the opponents may bear dangerous weapons. (H)

Ritualized response. (1) A response that appears in most members of a species, that is relatively invariant in topography, and that is typically a social releaser. (2) A response that appears in the repertoire of the members of several different but related species and that usually varies in stereotypy from species to species. (V)

Rolling. An activity characterized by lying down and rolling onto the back accompanied by rubbing movement against the ground. Considered to be a comfort movement. [HWS]

Round dance. With rapid rocking steps, the forager bee moves in circles which are often so tight that only one comb cell lies inside. The round dance signifies that a rich source of food lies in the vicinity of the hive, to a distance of 25 m. (V) (see waggle dance, sickle dance)

Roost. Refers to the place where birds spend the night. A communal roost is where a number of individuals come together during the night in a social group. (HJB)

Ruffling. Erection of feathers. Without doubt the primary function of feather ruffling is temperature regulation. In this connection three feather positions have been distinguished: ruffling, or extreme erection, with feather tips separated from one another, thus opening a passage for air to get to the skin for cooling; fluffing, in which erection stops short of separation of the feather tips and so increases the thickness of the insulating layer for heat retention; and sleeking, which contrasts with erection in that the feathers are depressed against the skin surface, thus reducing the thickness of insulation and reducing heat retention. Feather erection may be restricted to certain parts of the body, depending upon the conditions. For example, the feathers around the brood patches are ruffled as part of the sequence of settling movements with which a bird lowers itself onto its eggs to incubate them.

Special forms of feather ruffling have frequently evolved for the secondary function of display, often with associated modification of the shape or coloration of particular feathers, as in crests and plumes, the capes of pheasants, and the ruffs of ruffs. Such ritualized ruffling is especially prominent in the displays of threat behavior and courtship, where they may function as releasers necessary for the conduct of social interaction. For example, in many of the species in which allopreening occurs, a slight ruffling of the plumage can indicate where on its body the recipient of the attention would like the preening directed. (IB)

Runaway process. Runaway selection. Refers to the situation in which females choose males on the basis of heritable, favorable characters and in this way the genes for the female preference and the genes for the favorable male character end up in the same individuals. When this happens the female preference genes increase in the population by virtue of their association with the favorable male character. This can result in the evolution of extravagant male characters. [HJB] A form of sexual selection that occurs when female mating preferences for certain male attributes create a positive feedback loop favoring males with these attributes and females that prefer them. [JA]

Rut. In mammals a periodically occurring state of sexual and mating behavior controlled by male sex hormones.

S. (1) selection coefficient; (2) speciation rate

Saltation. A discontinuous, major evolutionary change in phenotype occurring between two generations.

Saltatory conduction. Action potentials move down nerves at an increased rate due to the presence of myelin and the fact that only intermittent regions of the neuron are depolarized.

Sample. A subset of a population; a group of items drawn by some stated procedure from a population and from which one hopes to learn certain things about the population. (E)

Sampling error. Statistical deviation from the previous genetic composition of a population resulting from random factors in the production or selection of the next generation; in reference to genetic drift in small populations. (MD)

Satellites. Periperial males. Males that remain near mated or paired males who are displaying conspicuously or maintaining a territory. In this way these satellite males may gain access to the female. (HJB)

Satiation. A state of motivation, usually, but not always referred to in the context of feeding. When feeding undisturbed from a source the animal spontaneously ceases.

Satiety. A state of motivation in which an animal stops performing a behavior even though the external stimulus situation is still present. Often used in the context of sexual behavior. (HJB)

Scan Sampling. A whole group of subjects is rapidly scanned or censused at regular intervals and the behavior of each individual at that instant is recorded.

Scansorial. refers to climbing or adapted for climbing.

Scatter hoarding. The caching of food in a dispersed manner through the environment in contrast to larder hoarding. (HJB)

Scent marking. The deposition of chemical substances on the substrate. They are usually secreted by specific scent organs and function in communication, particularly territory defense.

Schooling. The formation of a social group in fish, often tightly coordinated in their behavior.

Score-keeping mutualism. A type of mutualism that depends upon repeated exchange of favors and in which each participant adjusts its behavior in response to partial or total nonreciprocation by the other. Two of a family of such strategies for the prisoner's dilemma are Tit-for-tat and Judge. See also mutualism and reciprocity. (Brown 1987).

Scout bees. Bees that search for new supplies of food or a new nest site; when returning home they transmit their news to their hive mates with a dance.

Scramble competition polygyny. A mating system in which males are nonterritorial and seek scattered, receptive females.

Scratching behavior. Birds scratch on the substrate by using first one and then the other leg as in chickens, called alternate scratching. Other species such as thrushes and finches spring forward with both legs at the same time pulling the claws backwards over the surface, called hop scratching.

Search image. In the search for food or prey, an animal develops through trial and error a certain memory of the goal object. From this behavior results a searching image which produces selective searching. This leads to a change in the ability of the animal to locate particular types of food. This is particularly important when searching for cryptic prey. [HJB] A hypothetical mental picture of a prey item used by a predator to search specifically for a cryptic, common, edible prey. [JA]

Separate nesting. A system of parental care in plural-breeding birds in which each breeding female has her own nest, as opposed to joint nesting.

Segregation. The separation of homologous alleles at meiosis. (BC)

Segregation distorter. When the separation of homologous alleles at meiosis is not even. (BC); Any of several mechanisms by which there is a non-random distribution of chromosomes in to the daughter cells at meiosis. See meiotic drive.

Selection. Nonrandom differential survival or reproduction of classes of phenotypically different entities. See Natural selection, artificial selection, sexual selection. (F)

Selection coefficient. S, the measure of the disadvantage in survival a given genotype holds relative to that of the most fit genotype in the population (mD); The relative rate by which the frequency of a given genotype is reduced each generation by selection. (WB) (mD)

Selectionist. Differences in the amount of genetic variation in a population are due to the action of natural selection (see neutralist); also, generally the viewpoint that the observed characteristics of animals are due to the action of natural selection (adaptations) rather than being due to other mechanisms such as mutation and genetic drift.

Selective agent. The factor responsible for a particular selective pressure.

Selective breeding. Artificial selection.

Selective pressure. Any feature of the environment that results in natural selection; for example, food shortage, the activity of a predator, or competition from other members of the same sex for a mate can cause individuals of different genotypes to survive to different ages, to reproduce at different rates or both. (W)

Selfish herd. A group of individuals each one of which uses the others as living shields against predators. [JA]

Semantics. In communication, the study of relations of signals to their referents. The "messages" of communication.

Semilethal. A recessive lethal gene which lacks complete penetrance and expressivity, that is, kills less than 100% of the homozygotes before reaching sexual maturity.

Semiotics. The study of communication.

Semispecies. (1) One of several groups of populations that are partially but not entirely reproductively isolated from each other by biological factors (isolating mechanisms); populations that border between subspecies and typical species. (D) (2) Populations which are reproductively isolated in some areas of their range, but intrograde in others.

Sense organ. An organ specialized for the reception of sensory stimulation. (IB)

Sensitive period. Period of time during which a developing animal is especially sensitive to particular types of experience. (DM)

Sensory. Refers to the sense organs.

Sensory exploitation. In communication when a signaler is able to tap into the pre-existing biases of the sensory system of the receiver with the consequence that its message has more impact than it otherwise would. [JA]

Sentinel behavior. In many species one or several individuals sit in a conspicuous location and warn other members of the group of impending danger, often, associated with loud calls or visual displays.

Separation call. A vocalization made when an individual is removed from its group or becomes separated from conspecifics or other social partners. [HWS]

Sequential hermaphrodite. Refers to a hermaphroditic species in which the organism is only one sex at a time, being first male (or female) and then turning into the other sex later.

Sequential patterning. The pattern of producing different action patterns, for example the bout structure or the kinematic structure of behavior.

Serial homology. A relationship among repeated, often differentiated, structures of a single organism, defined by their similarity of developmental origin; for example, the several legs and other appendages of an arthropod. (F)

Serial monogamy. Refers to a mating system in which animals are monogamous for one breeding season but then normally change their mates before the next breeding season.

Sex attractants. Pheromones produced by individuals of one sex that attract the opposite sex.

Sex-limited. A trait which is found in only one sex.

Sex linked. A gene carried by one of the sex chromosomes; it can be expressed phenotypically in both sexes. (F)

Sex ratio. Refers to the ratio of males to females in a population. Primary sex ratio is measured at the end of parental care; functional sex ratio is measured at the time of breeding. (see also operational sex ratio)

Sexual behavior. Includes all behavior leading to the fertilization of eggs by sperm. Once fertilization has taken place, there may be further sexual behavior directed toward further fertilizations or there may be a switch to some form of parental care. (DM)

Sexual cannibalism. The consuming of the mate during or shortly before or after copulation.

Sexual dimorphism. Differences in appearance between males and females.

Sexual imprinting. A learning process occurring in young animals that determines what its preferences will be in pair formation.

Sexual reproduction. Production of offspring whose genetic constitution is a mixture of two (potentially) genetically different gametes. (F)

Sexual selection. The differential ability of individuals of different genetic types to acquire mates. Sexual selection consists of epigamic or intersexual selection, based on mate choices made by males (male choice) or females (female choice) and intrasexual selection, based on competition for mates between members of the same sex. (W)

Shaking to death. Vigorous side-to-side head shaking of prey used by canids and a few other species where death of prey is caused by neck dislocation or suffocation. (IB).

Sham attack. A ritualized threat behavior in which the feigned attack is stopped just short of the opponent.

Shaping. See approximation conditioning.

Shifting balance theory of evolution. S. Wright argued that evolution would proceed most rapidly if natural populations were subdivided into small partially isolated groups where there is some genetic drift but not enough to lead to fixation. This was followed by interdemec selection between the differentiated subpopulations. This occurred by the selective diffusion of characters from demes with the more advantageous genetic combinations.

Showing the nest behavior. A component of courtship behavior in many birds and fish in which the male draws the female toward a potential nest or nesting hole.

Siblicide. The killing of siblings.

Sibling species. Morphologically similar or identical populations that are reproductively isolated. (M) Species that are difficult or impossible to distinguish by morphological characters.

Sib mating. Mating of progeny derived from the same parents.

Sickle dance. Refers to a bee dance which is intermediate between the round dance and the waggle dance and indicates a rich source of food between 25 and 100 m.

Sign stimulus. A specified part, or change in a part, of the environment correlated in an orderly manner with the occurrence of a species-specific response that is not a reflex response. (V)

Signal. In ethology any behavior that conveys information from one individual or from one group to another regardless of whether it serves other functions as well.

Signal jump. A conspicuous and common courtship display behavior of fish especially Pomacentridae. The fish swims upward above the substrate, the anterior end pointing slightly downward. Then the fish drops swimming rapidly downwards toward the substrate, thus inscribing an arc.

Signature display. The species-typical head bobbing display pattern of territorial lizards. (HJB)

Signature whistle. The unique calls of individual organisms, especially dolphins.

Silent mutation. Mutation in a codon or sequence that does not cause an amino acid change.

Simultaneous hermaphrodite. Refers to a hermaphroditic species, animals or plants, which are both sexes at the same time.

Silverback male. Dominant male in groups of gorillas often with a gray marking on the back.

Singular breeding. A communal social system in which no more than one female breeds in each social unit, as opposed to plural breeding.

Sitting. Body position in which the posterior of the body trunk is in contact with the ground and supports most of the body weight. [HWS]

Skimming. A short period of running on the water and vigorous flapping of the wings by some species of waterfowl prior to take-off from water surface. [HWS]

Skinner-box. A space enclosed by a floor and walls of one or another material through which the study animal cannot escape. It is provided with one or more objects, the movement of which will automatically deliver a reinforcing stimulus. The manipulandum may be a key (to be pecked by a pigeon), a bar (to be pressed by a rat), or a string (to be pulled by a rat), or a panel (to be pushed by a dog or monkey). Used in studies of operant conditioning. (V)

Skototaxis. The movement of motile organisms toward darkness.

Slavery. The relation in which workers of a parasitic ant species raids the nest of another species, captures brood, usually in the form of pupae, and rears them as nest mates. After emergence the slaves work within the host colony.

Sleeking. See ruffling.

Sleep. (1) The recurring phases of inactivity in the circadian cycle of an animal. The preparatory movements and sleeping postures are species specific. (2) A behavioral phenomenon characterized mainly by prolonged periods of immobility and an increased reluctance to respond to stimulation.

Smiling. (1) An expression common to all humans serves as an appeasement display to divert aggressive behavior or as a salutation. (2) In any mammal a facial expression in which the corners of the lips are drawn back.

Sneaky copulation. Matings that occur outside the pair bond or harem, often by young males that avoid detection by the paired or harem males. also called cleptogamy

Sneezing. A sudden, powerful expulsion of air through the nose and mouth induced as a reflex spasm. [HWS]

Sniffing. A series of brief inhalations of air occurring during olfactory investigation. [HWS]

Social behavior. Behavior having to do with interactions between conspecifics (IB)

Social Darwinism. A political or economic doctrine based on the survival of the fittest, where the fittest are those individuals, companies, countries or social systems which can survive in the face of competition from other similar units.

Social deprivation. See Isolation experiment.

Social facilitation. The tendency for an action by some members of a group to be taken up by others.

Social group. A group that is formed by mutual attraction of the participants to one another. (contrast with aggregation).

Social inhibition. Suppression of an actions by one individual through the influence of another

Social learning. See tradition.

Social organization. The totality of social relationships from simple cooperation between males and females and territoriality to complex societies. (DM)

Social parasite. A species that takes advantage of the communication signals within social insect nests for furthering its own fitness. For example, there are species of beetle that acquire the odors of an ant colony and thus are accepted into the nest where they feed on the ant larvae. (HJB)

Social status. The rank in the social hierarchy attained by an individual as a consequence of its interactions with other members of the group. [HWS]

Social unit. Groups of two or more individuals that associate together and behave in some respects as a unit, especially in group territoriality.

Sociality. The tendency of animals to form social groups.

Socialization. Acquisition of social capability through experience of interaction with conspecifics as result of growing up in a group.

Sociobiology. A discipline that uses evolutionary theory as the foundation for the study of social behavior. [JA] The study of social behavior from an evolutionary perspective; the application of animal studies to human behavior. [HJB]

Sociogram. A graphic representation of social relationships or interaction frequencies in a group. Individuals are usually represented as labeled boxes or circles connected with arrows to indicate how often each one does what to whom in a sampling of the behavior of a group. Such an information network can display, for example, the dominance interaction in a hierarchically organized group. (IB)

Sociometry. Quantitative description of the social relationships within a group, the behavior patterns of its members, and the organization of the group. One of its methods consists of measuring the distances between group members and the directions they face relative to one another (see Attention Structure). (IB)

Software behavior. Not hardwired behavior.

Soldier. In social insects the caste that defends the colony from attackers, usually provided with larger defensive organs.

Solitary. A designation used in biology for species in which individuals form no enduring groups or pair bonds, but live most of their lives in a solitary state. (IB)

Song. (1) The long territorial vocalizations of passerines. (2) Any of a number of long and complex auditory signals produced by organisms. (HJB) In ethology and bioacoustics, usually sound production of a length and complexity that distinguishes it from shorter and simpler calls. However, songs and calls overlap so much in both length and complexity that the distinction is often hard to sustain, at least on morphological grounds. (IB)

Song imprinting. Said to apply in bird species in which the song is learned during a more or less clearly defined sensitive period, after which there is little or no capability of learning new or additional patterns. Song acquisition of this sort thus shows the essential characteristics of other kinds of imprinting (a sensitive period and irreversibility). However, such song often begins to emerge some time after the end of the sensitive period, so the "imprinting" applies more to acquisition of a template, to which the bird later matches its song production, than to production of the song itself. (IB)

Song matching. When the song type of one bird is matched by another, usually a neighbor or rival male.

Song repertoire. In the bioacoustic literature, an inventory of the song types or song phrases available to an individual. The term is used mainly of male songbirds. (IB)

Sonogram. Tape recordings of vocalizations can be run through a sound spectrograph which registers the amplitude, frequency and sound pressure and prints this information as a sound picture on a special kind of paper. (H)

Spacing behavior. A behavior pattern that serves to maintain a particular inter-individual distance. (H)

Spawning. The release of gametes or eggs into the water.

Specialist. Feeds on only one or a very few food items.

Specialization. A contracting, over evolutionary or individual time, of an individual's or species ecological roles or niche.

Specialized. Applying to an organism or character judged to be more changed from a presumed common ancestral state than another with which it is compared. (E)

Speciation. Species originate when two separately evolving subspecies diverge to the point where the differences between them amount to between-species differences. As with the general difficulty of defining species, so is it often hard to decide when this point has been reached. As a rule speciation involves a period of geographic isolation, during which the subspecies undergo differential adaptation consequent on the differences between their habitats (see allopatric). Whether speciation can also occur when the subspecies occupy a single region (se-called sympatric speciation) is a question extensively discussed in the literature; indisputable evidence of sympatric speciation is still wanting. It is at least feasible that a group's very strong fixation on a particular part of the habitat could lead to reproductive isolation from other groups of individuals, which could lead to species-generating divergence. This, of course, may also be viewed as allopatric speciation, the spatial separation simply being on a much smaller scale--microgeographical isolation, as it were.

If two allopatric populations resume contact and if interbreeding is still possible, the hybrids may prove less fit than the offspring from matings within each group; in that case selection will result in the erection of barriers to interbreeding. Behavioral mechanisms, such as

increased selectivity during pair formation, frequently contribute to the establishment of such reproductive isolation.

Speciation of a different sort is shown in collections of fossil material. Here a single lineage may change over time to such an extent that forms from later strata may be considered as representing a different species from those in earlier strata. The judgments are made on the basis of morphological criteria and breaks in the fossil record. A species is judged as having been transformed into a different species as a consequence of accumulated difference with the passage of time. This view of speciation represents it as a continuous process of microevolutionary changes within species. This view has been challenged by one that describes phylogenetic history as consisting of punctuated equilibria.

Speciation rate. S, the numbers of new species added per million years. (SS)

Species. (1) A phenotypically distinct, reproductively isolated aggregate of interbreeding populations. (M) (2) In the sense of biological species, the members in aggregate of a group of populations that interbreed or potentially interbreed with each other under natural conditions. (3) A basic taxonomic category to which individual specimens are assigned, which often but not always corresponds to the biological species. (F)

Species-area relationship. There is a correlation between the equilibrium number of species found on an island and the area of the island (m² or km²); also thought to apply to mainland situations.

Species recognition. In ethological writing, an exchange of stimuli between the sexes that ensures that the partners are conspecifics, thus preventing the mating of individuals of different species. The concept thus applies to those elements of courtship behavior that govern the meeting of opposite-sex individuals of the same species, which accordingly serve to effect reproductive isolation. However, Mayr (1963) has rightly pointed out that the term "recognition" is misleading if it is taken to imply consciousness, as it does in ordinary talk about people; the lower animals have mechanisms for species recognition that are just as effective as those of higher vertebrates, yet most ethologists would dispute or dismiss the idea that such animals have consciousness. (IB)

Species replacement. When two species come in contact with one another (after a period of allopatry), one of the two may outcompete and eliminate the other from the region of overlap.

Species selection. Differential survival of species over evolutionary time.

Species-specific behavior. (1) Those behaviors shown by a great majority of members of a species in the same or highly similar environments and under the same or highly similar conditions. (2) Those behaviors, complex and relatively stereotyped, that appear in most members of a species under set and stable conditions without evident prior opportunity to learn. (V)

Species-specific response. A response that is a part of species-specific behavior. (V)

Specific Action Potential or SAP. The potentiality or readiness of the whole animal for response to a given stimulus. (V) Hinde suggested that the Lorenzian concept of reaction specific energy as an internal activator of behavior should be replaced by SAP which can actually be measured from the behavior. An animal's SAP status is dependent on its readiness or tendency to perform a particular instinctive behavioral pattern in preference to all other behaviors. This tendency declines or ends after the consummatory act of the instinctive behavior has been performed.

Spectral sensitivity. In the study of animals' visual capacities, the relationship between response threshold and light frequency. For example, the activity in an animal's optic nerve fiber can be recorded while shining light of different frequencies on its receptive field on the retina to find the minimum intensity of each frequency that will cause a change in the activity of the fiber. The result is usually a U-shaped curve, the low point of which indicates the part of the frequency spectrum to which the unit is most sensitive. (IB)

Speculum. (1) A white or colored patch on the body surface that contrasts with its background. (2) German ethologists use the term for the white area around and below the base of the tail of many social mammals (ungulates, lagomorphs, primates), as well as for the often iridescent patches on the wings of birds, the denotation most common in English. (3) The specula of ducks serve as a conspicuous signal for group cohesion, and males show them off by special movements during courtship. In the history of ethology they were among the first examples of intraspecific releasers. (IB)

Sperm competition. (1) Since females often mate with more than one male, there is often competition among ejaculates within the reproductive tract of the female for fertilizations or between sperm of different males in external fertilizing species. Specific behaviors and morphological structures have evolved to improve a male's chances at this sperm competition. (HJB)

Spindle. The ellipsoidal mass of protein fibers (microtubules) visible during cell division and thought to play a role in chromosome movement and division of the cytoplasm. (E)

Spite/spiteful behavior. Social behavior in which there is a net loss to the donor and to the recipient.

Splicing. (a) Gene splicing: manipulations, the object of which is to attach one DNA molecule to another; (b) RNA splicing: the removal of introns from mRNA precursors. (S)

Spontaneous activity. Many neurons fire continuously and have a resting level of spontaneous activity.

Spontaneous behavior. Behavior that occurs in the ostensible absence of any stimuli that can be shown to elicit or release, or to set the occasion for its occurrence. (V)

Spreading center. On plate tectonics, a linear, principally submarine ridge system at which new oceanic crust is added and from which adjacent tectonic plates diverge as a result of convective upwelling of magma. (WS)

Stability. Often used to mean constancy; more correctly used to mean the propensity to return to a condition (a stable equilibrium) after displacement from that condition.

Stabilizing selection. The elimination of phenotypes of either extremes from the population by natural selection and hence of the genotypes that produce them; extreme deviants might include the largest as well as the smallest specimens, longest and shortest beaked, and so forth. (mD) (= optimizing selection)

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Stand. To assume or maintain an upright position on extended legs. [HWS]

Standard deviation. The square root of the variance. (F)

Stasigenesis. No anagenesis or cladogenesis in a lineage across evolutionary time.

Stasipatric speciation. A type of sympatric speciation in which isolation is achieved by karyotype reorganization.

Stasis. Little change in a lineage over long periods of time.

Statocysts. Sensory receptors that allow the detection of position with respect to gravity.

Status badge. See badge of status.

Status signal. A term applied to a sign that displays a specific socially relevant characteristic to conspecifics, such as position within a rank order or age or experience of a prospective mate. Thus the highest-ranking male in a group of gorillas displays a conspicuous silver-gray marking on its back (silverback male), in contrast to the black coloration of the rest of the members. In many songbirds there is evidence that color markings on the feathers signify rank position within a group (see Badge of Status). In other songbirds the older males that have more breeding experience possess larger song repertoires and in competition with other males acquire larger or better-quality territories. (IB)

Stellate ganglion. A group of cells found in the nervous system of molluscs such as squid that controls the escape response. The stellate ganglion has projections to the muscles of the mantle that allow rapid contraction for quick escape.

Stenotopic. Of a species or population, restricted to or capable of persistence in a narrow range of conditions or habitats; see Eurytopic. (F)

Stereotypy. A term applied when members of a set of successive instances of a response do not vary in their quantitative topographic characteristics. (V) A behavior is usually considered stereotyped if the coefficient of variation is less than 30%.

Stimulus. (1) A reversible change in the external or internal environment which is above a certain threshold and elicits one or more sensory excitations. (2) A physical event impinging on the receptors of an animal and capable of exciting those receptors. (3) A specified part, or change in a part, of the environment correlated in an orderly manner with the occurrence of a specified response. (4) Loosely used as synonymous with stimulus object (an object which produces stimuli) and with stimulus event (an event which produces stimuli). (V)

Stimulus filtering. Selection, from the total stimulation presented by a situation of those stimuli that elicit and regulate behavior (see releasing stimulus; sign stimulus). The filtering can occur in the sense organ, where the receptors exclude part of what they receive or block transmission of its effects (peripheral filtering). But as a rule at least some of the filtering takes place in the central nervous system, although in most cases little is known about where and how such central filtering occurs. It probably takes place in several successive steps. (IB) The capacity of nerve cells and neural networks not to respond to some stimuli.

Stimulus generalization. (1) A graded series of stimuli of decreasing effectiveness in eliciting a response. For example, an animal is trained to respond to a tone of 1000 Hz but will also respond to lower and higher frequencies without prior training. (2) The behavioral fact that a response

conditioned to one stimulus (or set of stimuli) will be elicited by or will occur in the presence of another stimulus (or set of stimuli) which is similar to the conditioned stimulus or discriminative stimulus although there has been no specific training to it. Changes in the strength of response to one will covary with changes in the strength of response to the other. (V)

Stimulus habituation. Eventually following repeated presentations of a stimulus the given response wanes. This stimulus-specific waning occurs in the sensory organ and the primary sensory centers; when the stimulus is withdrawn the sensitivity returns.

Stimulus specificity. Stimulus selectivity. The selective responsiveness to stimulation characteristic of a receptor or a behavior pattern. The "tuning" characteristics of physiological or behavioral response systems. (IB)

Stimulus summation. In ethology this usually refers to the additive effects of sign stimuli arriving together or in quick succession, as reflected in the strength or kind of response they elicit. (IB)

Stimulus threshold. The class of those values of quantified stimuli that will elicit some defined constant response at a fixed strength of less than maximal value. (V)

Stimulus-response correlation. An observed relationship between a stimulus and a response, such that a particular response can be shown to be dependent for its occurrence upon the just previous or concomitant occurrence of a specific stimulus or class of stimuli and to vary with variations in the conditions of presentation. (V)

Stochastic analysis. Statistical computation of the transition probabilities between items in mutually exclusive and collectively exhaustive sets, such as letters of the alphabet or the preening movements of a bird or fly. In applying such analysis to behavioral sequences, certain requirements have to be met such as that of stationarity, meaning that the transition probabilities must be stable, at least for the time covered by the sample of data. When the frequency of one item following another is greater or less than chance, the dependency is said to be Markovian or to conform to a Markoff chain model. If such a different-from-chance transition probability between two items is independent of the preceding items, the dependence is said to be a first-order Markoff chain; if the probability of B given A differs according to what immediately precedes A, the dependence is that of a second-order Markoff chain; and dependence extending farther back is labeled according to the same pattern. (IB)

Stochastic process. A process where the various outcomes can be predicted with a specified probability, but where the specific event cannot be predicted exactly (deterministically).

Stotting. A behavior which occurs in artiodactylids especially during fright, sudden disturbances and play. It consists of jumping from 2 to 12 times straight into the air with all four legs held stiff, the neck erect and the tail held in a horizontal to vertical position. The function of the behavior is not known. The sound of the hoofs striking the ground may serve to alert others or the visual exposure of the bright rump patches are possible explanations. It is also possible that the jumping allows the animal to monitor the source of disturbance in an area where the visibility is poor. The behavior is seen in open grassland species. Alternatively the behavior may demonstrate condition to the predator and prevent pursuit.

Strain. A selectively inbred stock.

Straining. A method of feeding in geese, some ducks and flamingos in which small organisms are passed through a sieve-like structure on the beak.

Strategy. In behavioral science this term has acquired a specialized meaning. (1) Formerly it was used only in roughly the same sense as "way of life". One still speaks of foraging strategies or reproductive strategies (monogamy, polygamy, family). (2) But in sociobiology the term has become associated with mathematical game theory. Roughly speaking, "strategy" in this sense refers to a comprehensive behavioral plan to deal with decision making; for each decision situation it prescribes a rule or an action or at least specifies the probabilities of results of different actions for the different situations. The game theory of evolutionary biology poses the question of how far strategies for dealing with conflicts between two or more individuals can be understood as adaptive. It is also concerned with how natural selection "evaluates" strategies. Complicating an analysis of this sort is the fact that not only are strategies adapted to the world (nonliving and living) outside the species, they also concern situations between members of a species; in many cases the decision is affected by what others are doing. To bring calculation to bear on this problem, the concept of evolutionarily stable strategy (ESS) has been developed. In the simplest case conceivable (assuming that most of the individuals of a population will adopt the strategy), one strategy is superior to all others. In this case an alternative strategy has no chance of becoming established or of displacing the first, which is therefore an ESS. (IB) A genetically distinctive set of rules for behavior exhibited by individuals. [JA] See pure strategy, mixed strategy and conditional strategy.

Stratigraphic sequence. Over time sediments are deposited in layers which make up a stratigraphic section. A fossil type found in each layer of deposits of a stratigraphic section becomes a stratigraphic sequence and can be studied for changes over time.

Stratigraphy. The arrangement of rock strata especially with regard to the chronologic order of the sequence. (WS)

Stress. A physiological condition that results from excessive environmental or psychological pressures or disturbances. This may be a pathological response or a specific and evolved adaptation for coping with prolonged life threatening conditions. (HJB)

Stretching. Behavioral sequences associated with extending the limbs or body musculature.

Stridulation. Sound production by rasp and scraper method most often in insects. Rubbing one body surface against another.

Stromatolite. A rock-like formation formed by communities of cyanobacteria and other prokaryotes in shallow water; formed during the Precambrian era.

Structural gene. (1) The DNA code unit whose primary product is messenger RNA and which thus controls synthesis of a particular protein or polypeptide. (E) (2) A gene that determines the primary structure (i.e. the amino acid sequences) of a polypeptide (see operon; regulatory gene). (S)

Structured demes. Individuals interact with only a very small subset of a total deme. The deme then is broken up into many smaller trait groups in which actual ecological interactions occur.

Subduction zone. In plate tectonics an elongate region where the lithosphere plate sinks below another part of the plate; where the plate descends into the mantle under the leading edge of another plate. (mWS)

Subjective probability. The subjects evaluation of the consequences of an action that it might take.

Submissive behavior. Behavior of subordination in order to prevent attack. Defensiveness.

Submissive coloration. A change of coloration in subordinate individuals. (H)

Subordinate behavior. The status of an individual in a group does not have access to resources or females. (see dominance).

Subsocial. (1) Refers to an association, either permanent or temporary, between a mother and her adult offspring. (2) The subsocial route to sociality refers to a long-term cooperative association between mother and offspring.

Subsong. (1) Fledgling vocalizations which lack the structure of the full song of the adult. (2) Low intensity song prior to full song production of adult animals.

Subspecies. A set of populations of a species that occupy different geographic areas and possess somewhat different characters.

Substitution. The complete replacement of one allele by another within a population or species; in the term nucleotide substitution, the complete replacement of one nucleotide pair by another within a lineage over evolutionary time (see fixation). (F)

Suckle. The behavior of young mammals when feeding on milk from the mother.

Sun bathing or sunning. Behavior that is associated with animals seeking out and basking in sunlight. Associated with thermoregulation. (DM)

Supergene. A group of two or more loci between which recombination is so reduced that they are usually inherited together as a single entity. (F)

Super-normal sign stimulus. A term applied to certain sign stimuli that have proven amenable to quantification along some scale. The sign stimulus, as it occurs in the field, falls at some point on this scale. To stimuli below this value, strength or intensity of response is less. If responses are given at greater strength or intensity to stimuli above this value, the stimuli of these magnitudes are referred to as "super-normal stimuli" (that is, they are more effective than "normal" stimuli).

Supernormal stimulus. A sign stimulus that is more effective in eliciting a response than naturally occurring actions or objects should be. [JA] A stimulus that elicits a particular behavior pattern more easily than the natural releaser which normally elicits the behavior. The innate releasing mechanism responds specifically to the characteristics of the object or situation for which the reaction has evolved.

Superorganism. Any colony possessing features of social organization analogous to the physiological properties of a single organism; any group of organisms acting as a single functional unit. [LBC]

Supernumerary. A member of a social unit in addition to the breeding pair. See discussion under helper.

Superstitious behavior. 1. Unless an experimenter is very careful, during shaping or approximation conditioning of a rat, or a pigeon, or a human subject, he may reinforce a response in which he is not interested or reinforce too often one of the responses that is in the approximation sequence of responses. These responses, occurring henceforth at a relatively high rate or in great strength, are referred to as superstitions or as superstitious responses. 2. If stimuli

that are usually reinforcing (e.g., food) are randomly delivered to a pigeon over a long period of time irrespective of his behavior, at the end of the period the subject can be observed to repeat over and over some response. Such a response is termed superstition.

Superspecies. A group of semispecies. (F)

Supernova. A stellar explosion.

Suppressor gene. A gene that can reverse the effect of a specific type of mutation in other genes. (S)

Suppressor mutation. A mutation that totally or partially restores a function lost by a primary mutation and is located at a genetic site different from the primary mutation. (S)

Survival value. The survival of a trait within a population depends upon the extent to which the trait contributes to reproductive success. (DM)

Swarming. Process of colony fission in honey bees. Also refers to a mating system of flies in which individuals (usually males) fly in close proximity usually over a high point in the environment with the effect of attracting females.

Switching site. Break points at which gene segments combine in gene rearrangements. (S)

Symbiosis. An association between two or more organisms which benefits at least one of them.

Symbolic behavior. 1. Verbal behavior. 2. A hypothesized class of behavior that cannot necessarily be directly observed. 3. The observed behavior from which symbolic behavior (2) is inferred. 4. Loosely and colloquially, thinking.

Sympathetic nervous system. (See autonomic nervous system)

Symbiosis. A general term referring to any association among organisms of different species whether parasitic or mutualistic.

Sympatry. Pertaining to two or more populations occurring in the same geographical area (allopatric, parapatric). (D)

Sympatric speciation. Speciation without geographic isolation; the acquisition of isolating mechanisms within a deme. (M)

Symplesiomorphy. Shared ancestral character state (from cladistics) [Wil]

Synapomorphy. A shared, derived character (from cladistics) [Wil]

Synapse. Communicating junction between two nerve cells, between receptor and nerve or between nerve cell and effector organ. (IB) Electrical synapses between two cells have an immediate, physical connection whereas chemical synapses have a synaptic cleft over which chemical transmitters travel from the presynaptic to the postsynaptic side.

Synchronization. Temporal coordination.

Synergism. Combined action of two where one does not work alone.

Syntactics. In linguistics, the rules governing how words are combined from phrases and sentences. (IB) In communication the study of relations among signals. In bird song, how the component parts of songs are organized. In somcommunication, the study of relations among signals.

Systematics. The comparative study of the historical, evolutionary and genetic relationships among organisms, and of their phenotypic similarities and differences. (mF)

Systemic mutation. A mutation, postulated by R. Goldschmidt, that would fundamentally reorganize the germ plasm, and permit the origin of wholly new types of organisms. (= macromutation). (M)

t. Amount of time elapsed (may be min, hr, d, yr, generation).

T-maze. A T-shaped pathway basically similar to a runway. The starting box is at the base of the T, and goal boxes are at each end of the cross-piece. On a trial, food or water may be placed in either or both goal boxes. Discriminative stimuli are sometimes placed in the arms of the T. (V)

Tabula rasa. The notion that the brain at the time of birth is without preprogrammed behavioral elements and that all behavior is the result of information acquired during the individual's life.

Tactic. One of the options that may be exercised by an animal whose behavior is guided by a conditional strategy. [JA]

Taming. A process that progressively reduces and eliminates animal's initial tendencies to flee and act negatively toward humans. (IB)

Tandem running. Behavior found in social insects in which one individual follows closely behind another during exploration or recruitment. [LBC]

Taste. Contact chemoreception.

Taste aversion. A form of conditioned learning, bait shyness. Learned avoidance of a particular type of food that has caused an animal to become ill after eating it. [HWS]

Taxis. (1) Orientation reaction or movement in freely moving organisms as opposed to tropism in sessile organisms. (2) A term applied to a broad class of behaviors specifiable in terms of the responses (locomotor and orientative) and of the stimuli (most often visual) controlling them. (V)

Taxon. (pl. taxa). The named taxonomic unit to which individuals or sets of species are assigned; may be a species, genus, family or whatever. Higher taxa are those above the species level. (F)

Taxon cycle. Replacement of species of a given taxon within a community over evolutionary time, such that predominant species vary cyclically in character.

Taxonomy. The naming and assignment of organisms to taxa. (F)

Tectonic. refers to the movement of the plates that comprise the earth's crust and to the deformation of those plates. [LBC]

Teleology. The doctrine that natural phenomena result from or are shaped by design or purpose. teleological. [LBC]

See Teleonomy.

Teleonomy. The scientific investigation of programmed purposiveness (Osche 1973) in living organisms and in certain man-made machines. Behavior patterns are quite prominently teleonomic; that is, they often appear "goal-directed" yet can be fully accounted for in terms of antecedent proximate causation. Teleonomic behavior is governed either by a genetically determined (closed) or experientially acquired (open) program, and through this program behavior is adjusted in fine detail to the prevailing environmental conditions to arrive at some end state; in this sense the behavior is purposive. Such adjustment is often achieved through the guidance furnished by feedback.

Telotaxis. A type of orientation in which the animal makes a direct approach to the stimulus source. (V) The process by which animals attain directional orientation without having to compare the stimulation from two receptors. It is found in animals that have sensory organs such as the vertebrate eye that are capable of providing directional information as a result of their structure. (DM)

Template. A term used in bioacoustics for information placed in memory that provides a model against which an animal can match its own production during vocal development. In many songbirds the young males have to learn their songs, often quite early in life, from the father or other exemplars. This learning often occurs far in advance of initial song production, in many cases during a limited sensitive period (see Song Imprinting). At this time the young animal acquires a template, or "sound print" of the exemplar by ear, to which it compares its auditory feedback in shaping its own song during later development. Artificially deafened songbirds which cannot hear their own song and cannot compare it to the template, develop very atypical songs as a rule. For bird species in which the song is at least partly genetically programmed, some authors talk of an innate template that maybe completed or modified through experience. (IB)

Temporal patterning. The structure of behavior based on its timing characteristics, usually inter-act interval.

Teneral. Refers to immatures in some groups of insects.

Teratology. The study of abnormal development. (SG)

Termination codon. A codon that specifies the termination of translation. (S)

Termination sequence. A DNA sequence at the end of a transcriptional unit that signals the end of transcription. (S)

Termiticolous. Inhabiting termite nests.

Terricolous. Living on or in soil.

Territorial advertisement. Refers to all the mechanisms by which individuals defend territories from intrusion by conspecifics including territorial scent marking, singing, and visual displays.

Territorial marking. The posting and designation of a territory with specific chemicals.

Territorial song. Singing that advertises possession of a territory to rivals of the same sex, a form of marking behavior. Territorial marking is probably the main function of song in most songbirds and many other animal groups. But much territorial singing also serves other functions as well, such as attracting unmated partners. (IB)

Territoriality. The defense of an area against conspecifics; interspecific territoriality is defense against other species which are usually competitors or egg predators.

Territory. A part of the home range which is defended from intrusion by conspecifics or a specific location in which an individual, the owner, is dominant. A fixed area from which rival intruders are excluded by some combination of advertisement, threat, and attack (Brown, 1975).

Tertiary. A geological period of the Cenozoic era, 65-16 my ago.

Tethys Sea. The oceans surrounding the super-continent of Pangaea.

Thanotosis. Playing dead; death-feigning behavior.

Thelytoky. All-female species reproduce in this way by parthenogenesis. (K)

Theory. A set of statements about empirical concepts, relationships among them, and hypotheses postulating further relationships among them. Theories often include statements involving the empirical concepts of a universes of discourse other than that in which the theory is derived. (V) A scientifically accepted general principle supported by a substantial body of evidence offered to provide an explanation of observed facts and as a basis for future discussion. [LBC]

Thermoneutral zone. The range of environmental temperatures in which an endothermic organism can maintain a stable body temperature without metabolic heat production above that produced in the course of maintenance metabolism. [HWS]

Thermoregulatory behavior. Behavior associated with the animal maintaining its body temperature at an optimal level. (DM)

Thigmotaxis. A type of orientation in which animals orient by remaining closely associated with environmental features, e.g.. a rat running along a wall.

Thirst. A state of motivation which arises primarily as a result of dehydration of the body tissues. (DM)

Threat behavior. Avoidance behavior with aggressive motivation, for example intimidation display with elements of threat. Threat behavior is species typical behavior. 2. Those set of behaviors of an animal that have been shown to produce flight behavior at some strength in another animal (usually of the same species) when they occur in its presence. (V)

Threat yawning. A threat posture occurring in primates and in hippopotamus, in which the mouth is opened widely as in yawning but the behavior is not released by the physiological factors that release yawning.

Threshold. The strength of a stimulus which just results in a measurable characteristic response.

Thrust. A part of sexual behavior during mounting where the male moves the pelvis so as to touch the female with the intromittant organ this may occur before, during or after intromission.

Thwarting. In ethology this term usually refers to a situation in which appetitive behavior fails to achieve the stimulus conditions necessary for completion of the activated behavior sequence. More generally, any situation where ongoing behavior is frustrated in reaching its proximate goal by absence of the requisite stimulation. Its effects are similar to those of conflict among incompatible tendencies in that it can be the occasion for displacement activity, for example. (IB)

Tidbitting. A display by gallinaceous birds, originally consisting of pecking at the ground and calling, used for enticing chicks to approach and feed. In many species the behavior has been further ritualized and incorporated into courtship patterns, where it serves the secondary function of luring the female to the male. (IB)

Tit-for-tat. "This strategy is simply one of cooperating on the first move and then doing whatever the other player did on the preceding move. Thus tit for tat is a strategy of cooperation based on reciprocity." From Axelrod and Hamilton (1981). The game is a prisoner's dilemma.

Time sharing. As used by McFarland (1974) in connection with alternation between activities, a situation in which one of the activities controls when the other can occur. When the causal system for the controlling or dominant activity is in operation, it inhibits that of the other subdominant activity, which can be expressed only during pauses in the dominant activity, when the subdominant activity is disinhibited. Interruption of activities can indicate which one is dominant in a time-sharing situation. If the interruption occurs during performance of the subdominant activity and does not extend past the point of recurrence of the dominant activity, the temporal organization of the behavior will not be affected-the dominant behavior will resume on schedule. If the interruption occurs during the dominant activity, the next pause in that activity will be correspondingly delayed, thus altering the timing of the subdominant activity. Experiments using this approach are called masking experiments; they have produced evidence of time sharing in a variety of contexts, such as courtship in sticklebacks and feeding and drinking in doves. (IB)

Tobogganing. A locomotory pattern of penguins in which they slide on their stomach, propelling themselves forward with their feet.

Tongue-flicking. In many snakes tongue-flicking serves an orientation and olfactory function and involves the use of the Jacobson's organ.

Tonic. Refers to a neuron in which action potentials occur again and again.

Tonic immobility. Temporary inability to move manifested by an animal upon close exposure to or handling by some powerful agent such as a predator; death feigning.

Tool use. The fashioning of an object external to the body of the animal to accomplish some end. The manipulation of objects for purposes such as care of the body or acquisition and preparation of food. Tool use has been described for a large number of animal species and in connection with many different kinds of behavior. Hermit crabs slip into empty gastropod shells, which they carry around as a means of protection for their vulnerable abdominal segments. The Egyptian vulture throws stones at ostrich eggs to smash them and get at their edible contents; elephants hold sticks with their trunks to scratch their backs; and chimpanzees have been seen to use sticks to strike at leopards or pile boxes on top of one another to reach food hanging out of reach. The best-known cases of tool use include that of the Galapagos woodpecker finch, which takes a cactus spine in its bill and pokes it into bark to get insects, and the North American sea otter, which breaks open shellfish by holding them in its forepaws and dashing them against a stone cradled on its chest as it swims on its back. Still further examples have been reported for wasps, blue jays, and baboons. Sometimes even conspecifics are used as tools, weaver ants use their mandibles to pick up larvae, whose silk glands they apply to the edges of rolled-up tobacco leaves, working the larvae back and forth like weaving shuttles to "sew" the edges of leaves together. As adults the ants no longer possess silk glands. Some animals go so far as to fashion or improve the tools they use. Thus chimpanzees break off twigs from which they peel the bark and remove side branches before poking them down holes in termite nests to fish for termites. Also the woodpecker finch can break off the cactus spine it uses as a probe.

Cases have been reported of animals using objects as tools in novel ways apparently arrived at by perception of configural relationships rather than trial and error. Such cases have been cited as instances of insight learning. There are also cases of a particular kind of tool use being handed on from one generation to the next through tradition. (IB)

Topography (of a response). The full quantitative specification of all the relevant, physically measurable dimensions of a response. (V)

Trace fossils. these are fossils known only from their traces or the tracks they leave in the sediments such as footprints, burrows and paths rather than from the physical impression of the organism or its hard part remains.

Tradeoffs. The notion that animals cannot be equally good at everything, i.e. they might reduce disease by staying warm but insulating, they increase metabolism and thus reduce the amount of energy available for other activities such as reproduction.

Tradition. Knowledge learned by an individual is retained among the group members beyond the life span of the individual who introduced it. This transfer of knowledge or information from one individual to another and one generation to the next is referred to in ethology as tradition.

Trail pheromone. A chemical substance laid down as a trail by one individual and followed by another member of the same species. [LBC]

Train. To subject an animal to experimental procedures such that one or more of its responses become conditioned. (V)

Trait group. A highly localized aggregation of interacting conspecific organisms that may differ in the mean of some trait from other such groups, and which remains aggregated only temporarily (often for less than a generation).

Trans. Of two genetic elements, located on different homologous chromosomes within an individual genome; of gene action, influence of one genetic element on the function or expression of another genetic element located on another chromosome.

Transcription. In genetics, the conversion of the genetic information in a DNA sequence into a messenger RNA molecule.

Transduction. The transfer of genetic material from one cell to another by means of a viral vector. (S)

Transfection. Infection of a cell with isolated DNA or RNA from a virus or viral vector. (S)

Transfer function. Variation in the output level on a signal transmitter after a defined change in the input. (H)

Transformation. The introduction of an exogenous DNA preparation (transforming agent) into a cell. (S)

Transgression. The rising of sea levels to cover continental land areas thus greatly increasing the area of inshore communities. (see regression).

Transition probability. A measure of the likelihood p that a given behavior pattern will occur given that another behavior pattern q will follow.

Translation. The process in which the genetic code contained in the nucleotide sequences of mRNA directs the order of amino acids in the formation of peptides. (S)

Translocation. Exchange of parts of chromosomes among non-homologous chromosomes.

Transpecific evolution. Evolutionary phenomena and processes beyond the species level, such as the origin of new higher taxa, new organs, evolutionary trends, the extinction of faunas, and the like. (M)

Transposable element. A segment or fragment of DNA that can move from one position in the genome to another. (S)

Transposition. Movement from one site in the genome to another. (S)

Transposon. A transposable element. (S)

Transversion. A mutation caused by the substitution of a pyrimidine for a purine or vice versa.

Transverse orientation. Orientation at a temporarily fixed angle to the direction of the external stimulus or at a fixed angle.

Traplining. A feeding strategy during which an animal visits a sequence of widely dispersed food sources, obtaining a small part of its daily food requirement at each feeding location. [LBC]

Treading. Milk elicitation movement in many mammals. They use either their front or hind feet to paw at the teat during nursing. (H) In chickens behavior of males displayed in the copulatory mounting position prior to cloacal contact, characterized by several relatively fast movements of the legs. [HWS]

Treatment Effect. In statistics, the change in response produced by the particular variable that was isolated by an experimental manipulation.

Trench. The trough at the zone of subduction.

Triploid. Having three times the number of chromosomes in the haploid complement. (BC)

Trial. A single, experimentally manipulated occasion on which an instance of a specified response is elicited or may occur. (V)

Trial-and-error learning. (1) Operant conditioning as it is observed to occur under conditions where relatively precise experimental controls have not been established. (2) A mode of learning by repeated experience.

Triassic. A geological period of the Mesozoic era 240-210 my ago.

Triumph ceremony. Epigamic behavior pattern during pair formation in geese. The male at first makes sham attacks toward objects that are normally avoided. Following such an attack he triumphantly returns to his intended mate and threatens beyond her. If she joins the triumph ceremony, a defensive alliance has been formed which is a part of pairing. After pairing this behavior continues to maintain the pair bond but functions as a greeting ceremony.

Troglodyte. A subterranean organism, cave dweller.

Trophallaxis. Mouth to mouth exchange of food in social insects.

Trophobiosis. The relationship in which ants receive honeydew from aphids and other homopterans or the caterpillars of certain butterflies.

Tropism. The spatial orientation of sessile organisms due to differential growth.

Tropotaxis. A type of orientation. The process by which animals make a simultaneous comparison of the intensity of stimulation received from two or more receptors and can strike a balance between them. (DM) Two organs are differently stimulated, the difference causing a reaction bringing the animal in line with the stimulus where the organs are equally stimulated.

Type I Error. Rejecting the null hypothesis when it is in fact true (concluding there is an effect when none exists).

Type II. Error. Accepting the null hypothesis when it is false (i.e. failing to detect a real effect).

Typical intensity. Some displays are performed in a very stereotyped manner despite the fact that the underlying motivation varies. These displays are said to be released at a typical intensity. (HJB)

Typological. A type of thinking based on a concept in which variation is disregarded. (M)

Typology. A method of classification or study of natural groups based on the assumption that all members of a taxonomic unit conform to a given morphological plan without significant variation. [LBC]

Ultimate determinants of behavior. The evolutionary factors (adaptiveness and phylogenetic origins) that act to maintain the behavior in the population. (see proximate determinants)

Ultrasound. Sounds at frequencies above the range of human hearing. (HJB)

Ultraviolet light. The wavelengths of light that are just below the range of human vision but can be seen by bees and many other arthropods. (HJB)

Umwelt. Refers to the perceptual world of animals. Used in the context that an animal's umwelt is different from that of a human. The Umwelt is made up of the *Merkwelt*, the different sensory and processing systems and its *Wirkwelt* or effector world, the different ways of responding to the environment.

Unconditioned response. A regular and measurable response elicited by the unconditioned stimulus in the classical conditioning experiment. (V)

Unconditioned stimulus. In classical conditioning, a stimulus which evokes or elicits a regular and measurable response (the unconditioned response). (V)

Uniformitarianism. A theory of geology based on the premise that the geological processes that built past formations do not differ from those operating today (such as erosion and deposition). (mD)

Unimodal. A frequency distribution with one peak.

Uniparous. Producing one offspring at a time.

Univoltine. Having only one generation per year.

Unlearned behavior. (1) Species-specific behavior, the necessary and sufficient antecedents of which are unknown to, and often of little interest to, the investigator. (2) Behavior that has been experimentally demonstrated, in both its stimulus control and topography, to be independent of and unmodified by the operation of variables encountered in conditioning and learning, such as the occurrence of reinforcing stimuli. (V)

Unstable equilibrium. A frequency equilibrium between alleles in a population that is readily upset because of a selection disadvantage of the heterozygotes. (D)

Urine marking. A widespread behavior pattern among mammals in which the paths and boundaries of the territory are marked with urine. (H)

Utility. The animal's evaluation of the attractiveness of the alternative choices.

v_x . reproductive value; of an individual of a specific age, its likely contribution to the growth of the population.

Vacuum activity. (1) When an instinctive behavior has not occurred for an extended period of time, the threshold value for relating stimuli is lowered. This reduction in threshold may reach a point at which the response occurs without a demonstrable stimulus and hence the term vacuum activity. (2) The occurrence of a fixed action pattern in the apparent absence of its usual releaser or sign stimulus. (V)

Vagility. The dispersal ability of a species.

Variability, Coefficient of. In statistics the standard deviation expressed as a percentage of the mean.

$$CV = (s \bullet 100) / \text{where } s = \text{standard deviation.}$$

Variance. The average squared deviation of an observation from the arithmetic mean; hence, a measure of variation.

$$S^2 = \frac{\sum (x - \bar{x})^2}{N-1}$$

where $\bar{x}$ is the mean and N the number of observations. (F)

Variance enhancement. Increase in the variance of the reproductive potential among members of a parent's brood. The implication is that more brood members are thereby brought to lie above or below the threshold for breeding, thus increasing the proportion of the brood becoming breeders or potential helpers respectively. (Brown 1987).

Variance utilization. Utilization by parents of aid from those of their offspring that are unable to breed for reasons not imposed by the parents. The implication is that offspring vary in their reproductive potential, some being above the threshold for attempting breeding and some below. (Brown 1987)

Variety. (1) In zoology an ambiguous term for a set of phenotypic variants, whether they be nongenetic variants, morphs, domestic breeds or races. (M) (2) In Botany used to denote a variety in the zoological sense or, more commonly, a subspecies.

Venn diagram. A diagram that makes use of set theory to organize relationships; usually portrayed as three intersecting circles.

Ventral earth reaction. Orientation so that gravitational force acts perpendicularly to long and transverse axes of the body. The dorsal surface is usually kept uppermost.

Vector. An agent consisting of a DNA molecule known to autonomously replicate in a cell to which another DNA segment may be attached experimentally so as to bring about the replication of the attached segment. (S)

Vestigial structures. Morphological traits that were once functional in the phylogenetic history of the organism but now serve no useful function to the organism.

Viable. The capability of living or continuing development. (D).

Viability. A relative measure of the number of surviving individuals of any given phenotypic or genotypic class. [LBC]

Vicariance. Species evolved by allopatric speciation.

Vicariance event. The splitting or division of a species through the development of a natural biogeographical barrier. [LBC]

Vicariance biogeography. A method for assessing the degree of congruence in the distributional patterns of taxa. This method reveals common elements in distributional patterns and is used to reconstruct the evolutionary history of a taxon.

Vigilance. Conspicuous behavior associated with watching out for predators. Refers to an animal's state of readiness to detect certain specified events occurring unpredictably in the environment. (DM)

Virgin. An animal that has not copulated in its lifetime. Primarily used for females.

Virulence. The capacity of a pathogen to invade host tissue and reproduce; the degree of pathogenicity. [LBC]

Vision. The detection of light by eyes and the behavioral responses it produces. (DM)

Visual cliffs. Various nidifugous animals show an innate fear of a precipice which they recognize from the visual impression alone without themselves facing an experience with falling.

Vitalism. The view that phenomena exhibited by organisms are the result of supernatural forces as distinct from chemical and physical forces that exert directional effects on variation and evolution. [LBC]

Viviparous. Giving birth to live young. (K)

Vocalization. Production of songs, calls and other sounds by animals. The production of sound by means of a vocal apparatus. (DM)

Vocal mimicry. A term used in the bioacoustical literature for a species' habit of adding to its vocal repertoire sounds imitated from another species. According to the theory, Beau Geste hypothesis, vocal mimicry may give a false indication of higher population density to both conspecifics and members of other species in competition with the singer. (IB)

Vocal repertoire. Sound repertoire. Inventory of the sound patterns produced by an individual or a species.

Vocal simulation. Voice simulation; sound simulation. The playback of natural or artificial sounds, as a rule by tape recorder, to test their effects on the behavior of animals being studied for auditory responsiveness. By manipulating the sounds (transposing components in sound sequences, changing rhythm, filtering out certain frequencies), one can determine, from the reactions of the test animals, which are characteristic of a naturally occurring sound are significant to its effects and which are not. (IB)

Volant. Adapted for flying or gliding.

Voltine. Pertaining to the number of broods produced over the year. Bivoltine refers to two broods; univoltine to one.

Voltinism. A polymorphism in a species in which some members of the population enter diapause whereas others do not.

Vomeronasal organ. Just above the hard palate, the nasal mucosa covers this secondary organ of olfaction. The behavior called flehmen helps odors get into the incisive ducts of the vmo by opening the mouth and partially obstructing the nostrils. [BB]

Von Baer's Law. Development proceeds from the general to the special. The earliest embryonic stages of related organisms are identical; distinguishing features are added later as heterogeneity differentiates from homogeneity. Recapitulation is impossible; young embryos are undifferentiated general forms, not previous adult ancestors. (SG)

W. The fitness of a given genotype; the relative rate by which the frequency of a given genotype is increased each generation by selection. (WB)

Waggle dance. Refers to the communication behavior of bees indicating the direction and distance to a food source which is more than 100 m away. (see round dance, sickle dance)

Wallowing. Behavior in which an animal spends time rolling and lying in mud or muddy water. [BB]

War of Attrition. A game in which winners are decided simply by a contest involving waiting, or displaying, for different lengths of time. The solution is a mixed ESS of variable waiting times.

Warm-up. Over the first few occasions within a short period of time that a specified response occurs, response-strength may increase relatively rapidly, independently of reinforcement contingencies. Such increments in response-strength are termed warm-up. (V)

Warning behavior. Alarm behavior. Behavior performed in response to predators.

Warning coloration. See aposematic coloration.

Wavelength. The horizontal distance between the crests of adjacent waves. Wavelength of light refers to color and wavelength of sound refers to pitch.

W-chromosome. The sex chromosome which in the case of female heterogamety is present in the female only.

Weaning. The break of an offspring's dependence on its parents.

Weighting. A method of attaching different importance values to different characters. [LBC]

Wheel posture. Copulation posture in dragonflies which is determined by the unique position of the male copulatory organ on the second abdominal sternite.

Whitten effect. Synchronization of the estrus cycling of females housed together.

Wild type. The allele, genotype, or phenotypes belonging to the same population. (WB)

Wiping reflex. If frogs or toads eat some oversized or unpalatable object, they try to expel it by opening the mouth wide and moving the forelegs forward from the side in a wiping movement.

Worker. Among social insects an individual that does not or rarely reproduces and instead helps another individual (usually the mother) to rear offspring, construct nests, defend sites, etc.

Working hypothesis. A hypothesis that serves as the basis for future experiments or observations. [LBC]

Xenobiosis. The relation in which colonies of one ant species live in the nests of another and move freely among the hosts obtaining food from them by trophallaxis or other means.

Xenoparasite. A parasite infesting an organism that is not its normal host.

X-chromosome. The sex chromosome which in cases of male heterogamety is present in both sexes.

Xeric. Having little or no moisture. tolerating or adapted to dry conditions.

Xerothermic. Refers to organisms that are tolerant of hot environment.

Xylophilous. Thriving on or in wood.

Yawning. Wide opening of the mouth thought to be associated with a specific physiological function.

Y-chromosome. The sex chromosome which in cases of male heterogamety is present in the male only.

Yoked control. A methodology used in learning and imprinting experiments in which one individual is presented with the stimulus and the ability to manipulate that stimulus (such as pressing a bar to turn on a light in an imprinting experiment) whereas the other individual receives the same amount of stimulation but does not have control over the contingencies. The individual

in a yoked experiment that receives reinforcement contingent on a given operant response of another individual while its own performance of the same response does not result in its reinforcement. [HWS]

Z-chromosome. The sex chromosome which in cases of female heterogamety is present in both sexes.

Zeitgeber. Time giver. An external stimulus that brings an animal's endogenous periodicity into synchrony with environmental periodicity.

Zenith. The point on the celestial sphere directly above the observer or above a given point on the surface. [LBC]

Zig zag dance. The courtship behavior of the male stickleback in which he alternately moves toward the nest or female and then away. (HJB)

Zirkeln (prying movements). A feeding movement for birds in which the bird inserts its beak in a crevice in the ground, e.g., between grass roots or under the bark of trees, and then forcefully opens the beak thus expanding the hole and increasing its access to worms and insects. Conspicuous in starlings.

Zoomorphism. Giving humans animal attributes (opposite of anthropomorphism). (IB)

Zone of intergradation. The region of contact between two populations of contrasting phenotypes, in which a mixture of phenotypes occurs through interbreeding; sometimes called zone of hybridization. (D)

ZPG. Zero population growth.

Zugruhe. migratory restlessness.

Zygote. The cell created by the union of two gametes, in which the gamete nuclei are fused. (W)

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(Capital letters after the definition indicates the source: lower case "m" indicates a modification of the original definition.)

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